U.S. ARMY ENGINEER RESEARCH AND DEVELOPMENT CENTER

BACKGROUND

The research and development laboratories of the U.S. Army Corps of Engineers have served the Corps, the Army, and the Nation with technical accomplishments in a variety of engineering and scientific fields for more than 70 years. From beginnings in 1929 as a small hydraulics laboratory established to assist in developing a comprehensive plan for flood control of the Mississippi River to the 1999 establishment of the Engineer Research and Development Center (ERDC) consolidating the research and development efforts of the laboratories under the leadership of a single center, Corps' laboratories have been solving civil engineering and environmental quality challenges. ERDC offers a centrally managed center of seven laboratories that is the largest and most diverse civil and environmental research and development organization in the world.

During FY04, ERDC had 1865 employees of whom 1,036 are highly trained engineers and scientists. The professional staff encompassed 276 Ph.D.'s and 420 Masters' degrees.

ERDC executed a Civil Works program totaling $122 million; of this total, $49 million was executed in direct allotted R&D Programs. The remaining $73 million was executed in support of USACE District and Division offices and non-Corps customers.

LABORATORIES

The diverse civil engineering and environmental quality research and development center consists of seven centrally managed laboratories located at Alexandria, VA; Champaign-Urbana, IL; Hanover, NH; and Vicksburg, MS. With world-renowned expertise and facilities, each laboratory adds a unique perspective and set of capabilities to the overall ERDC team.

Coastal and Hydraulics Laboratory

The Coastal and Hydraulics Laboratory (CHL) is the Nation's center for engineering and scientific research and development in the coastal, hydraulic, and hydrologic engineering and sciences. It conducts research and supports the Corps of Engineers in conducting it's navigation, flood and coastal storm damage reduction, environmental restoration, and military engineering missions. CHL is comprised of nationally and internationally recognized experts that perform research and site-specific investigations in the fields of rip-rap design; navigation engineering; pump station design; fisheries engineering; sediment transport; estuarine engineering; dredging; hydrodynamics; groundwater, watershed, and surface water modeling; coastal storm and flood damage protection; harbor design and modification; coastal and hydraulic structures; physical processes associated with water resources; environmental problems; military logistics-over-the-shore; wave climatology; and hydroinformatics.

Cold Regions Research and Engineering Laboratory

The Cold Regions Research and Engineering Laboratory (CRREL) maintains the finest research and engineering staff and facilities in the world for the study of cold regions science and technology. CRREL's experience spans 60 years, starting with the Boston District's Soils Laboratory work on frozen soils in the early 1940s. The creation of CRREL began in 1961 with the merger of the Arctic Construction and Frost Effects Laboratory and the Snow, Ice, and Permafrost Research Establishment. This merger put the Department of Defense principal cold regions expertise in one place. In 1971 a long-term program by the Corps of Engineers to investigate ways of extending navigation on the Great Lakes-St. Lawrence Seaway throughout the winter also marked the beginning of Civil Works research at CRREL.

CRREL is recognized for its internationally known experts in the field of ice jam flooding and ice-hydraulics; ice control at locks, dams and other navigation channels; snowmelt modeling & simulation; and other areas ranging from geotechnical aspects of frozen ground to new admixtures for placing concrete in the winter. CRREL's specialized research facilities include a complex of cold rooms, an Ice Engineering Facility housing three special-purpose research areas; a large low-temperature towing tank, a refrigerated flume for

modeling rivers, and a large hydraulic-model room. CRREL is also home to the U.S. Army Corps of Engineers Center of Expertise for Civil Works Remote Sensing/Geographic Information Systems.

Construction Engineering Research Laboratory

The Construction Engineering Research Laboratory was chartered over 30 years ago to provide construction research that would address the entire spectrum of issues within military construction. This research is in support of sustainable military installations and encompasses construction, operations, and maintenance as well as environmental and safety concerns. These technologies have universal application and are of extreme value in the Civil Works arena as well. Civil Works efforts historically have been in the areas of corrosion control, high performance protective coatings (including over-coating of lead-based paint), management tools for Operation and Maintenance optimization, and environmental sustainment.

Environmental Laboratory

ERDC's Environmental Laboratory is the acknowledged international leader in environmental quality and environmental restoration research. Solving problems in these two areas has involved the Environmental Laboratory in evaluating and mitigating the consequences of water resources development, navigation, and dredging on the environment; regulating and restoring wetlands and inland and oceanic water quality; stewardship of natural resources; and managing cleanup of contaminated groundwater sediments and soils.

For over 30 years, an interdisciplinary staff of peer-recognized professionals, augmented with the finest network of academic and private scientists and engineers in the country, have provided the environmental quality and environmental restoration technology necessary to further the Corps' missions.

Notable examples of recent accomplishments include technology input to an ocean pollution treaty (London Convention), natural resource management to guide Corps stewardship at projects; improved techniques for stream and riparian restoration; research to accelerate growth of desirable, non-problem vegetation; distribution of the first-ever expert system/information manual on using biological control agents to manage nuisance aquatic plants; risk-based contaminated sediment and soil toxicological assessment protocols; and providing guidance to the field on controlling zebra mussel infestations using anti-foulant coatings (paints, thermal metal sprays, etc.), development of an upland disposal testing and assessment manual for dredged material, and continuous backwash filter systems for intakes that supply irrigation systems, water supply, and other low-flow requirements.

Geotechnical and Structures Laboratory

The Geotechnical and Structures Laboratory (GSL) was formed in October 2000, by consolidation of the Geotechnical Laboratory, established in 1931, and the Structures Laboratory, formed in 1983 by combination of the Concrete Laboratory and the Weapons Effects Laboratory. The Concrete Laboratory had existed at WES since 1946, when it was transferred from Mt. Vernon, NY. Formation of GSL was undertaken to capitalize on research synergies that had been developing over the years involving prediction of behavior of structures built in or with earth materials and the effects of weapons and explosives on earth materials or earth construction.

GSL conducts research in soil and rock mechanics, earthquake engineering and geophysics, tunneling and trenchless technology, engineering geology and seismology, vehicle mobility and trafficability, unexploded ordnance detection, and pavement technology. The Laboratory also researches the response of structures to weapons effects and other loadings, investigates methods for making concrete and other materials more durable and economical, studies the application of explosives technology to military and civilian engineering, and investigates the behavior of earth/structure systems subjected to blast loading and projectile penetration. GSL is a world leader in research on effects of earthquakes on embankment dams and the evaluation, maintenance, and rehabilitation of mass concrete, steel and reinforced structures.

Information Technology Laboratory

The Information Technology Laboratory (ITL) serves the U.S. Army and the Nation by advancing, applying, and delivering information technologies (IT) that address a wide range of engineering, scientific, and management challenges. As the lead in delivering end-to-end solutions across the IT spectrum, ITL provides the underlying, enabling technologies needed to solve problems and assists in the transition and infusion of products to the customer. ITL ensures the integration, synergy, and leveraging of IT and closely related technologies across ERDC and facilitates R&D program

development, management, integration, and marketing with particular emphasis in the areas of (a) information science, interoperability, and assurance and (b) computational science and engineering.

ITL manages one of the four High Performance Computing Major Shared Resource Centers formed under the auspices of the DoD High Performance Computing Modernization Program; and the CADD/GIS Technology Center for Facilities, Infrastructure, and Environment, a multi-agency vehicle to coordinate CADD/GIS activities within DoD and with other government agencies (one of two Corps of Engineers Enterprise Infrastructure Services Processing Centers). The Laboratory also has one of the largest high-bandwidth, high-speed data communication networks in the world, and one of the finest civil engineering libraries in the Federal Government.

ITL is also highly recognized for its expertise in the areas of Facilities Management technologies required by Army Civil Works projects; computer-aided interdisciplinary engineering and analysis; computer science applications; scientific visualization (including virtual reality); support to R&D and application efforts requiring sensors, graphic arts and publishing; and collaborative technologies.

Topographic Engineering Center

The Topographic Engineering Center (TEC) provides new topographic capabilities in geospatial science to the Civil Work's community to ensure superior implementation of the nation's civil and environmental initiatives through research, development, and application of remote sensing, geographic information, global positioning, topographic, hydrographic and information technologies. TEC scientists and engineers continue to develop faster, more accurate, and cost-effective ways to use new remote sensing technologies to describe, characterize, and analyze the surface of the earth. Remote sensing technologies form an essential part of a new national approach to infrastructure engineering and environmental stewardship.

Remote sensing tools can accurately characterize different surface characteristics, conditions, and future states, including certain types and conditions of vegetation, soils, and surface water. With further development, this will provide support in an effort to monitor and predict changes in the biosphere. These tools provide indicators for the location of point and non-point pollution sources as well as advise of impending negative or positive trends.

ARMY CIVIL WORKS R&D PROGRAMS

The Army Civil Works Research and Development program is formulated to directly support the established Business Lines of the Civil Works Program including: flood and coastal storm damage reduction, inland and coastal navigation, environment (including natural resources, compliance, mitigation, and restoration), water supply, hydropower, recreation, emergency management, and regulatory. The Civil Works R&D needs and requirements are identified based on the current Civil Works Program Strategic Plan, Corps divisions and district input, and the existing WRDA authorities. The R&D effort is a problem-solving process by which the Corps systematically examines new ideas, approaches, and techniques and develops field-ready products to improve the efficiency of its planning, design, construction, operations and maintenance activities in an environmentally sustainable manner.

Results of this R&D effort are directly incorporated into practice within the Civil Works Program through revisions or additions to Engineer Regulations, Engineer Manuals, Technical Guidance Manuals, Engineer Technical Letters, or Guide Specifications. Numerous other means of technology transfer are also used such as training courses, workshops, and other professional contacts. The Corps Civil Works R&D Program provides essential Product Lines with field ready end products and a high return on investment for the Corps and the Nation.

In order to most effectively use the limited R&D resources and to avoid unnecessary duplication of research effort, the Civil Works R&D Program maintains external technical exchange and technology transfer efforts with other Federal and major water resource agencies, International Boundary Water Commission, International Joint Commission, the Navy, and state and local governments.

Components of the R&D program include support to the major business lines of the Corps of Engineers. They are:

a. Navigation (includes hydropower)

b. Flood and Coastal (includes Emergency Management, Water Supply, and Recreation)

c. Environmental Restoration

Additional research serves to cut across and support all business lines. In particular, the System Wide Water Resources, Infrastructure, Geospatial, and Decision Support technology development serve multiple business needs.

Navigation Research Area

The Corps provides inland and coastal navigation critical to the national economy and defense. Additionally, Corps projects provide 25% of the Nation's hydropower. Navigation research, which includes hydropower, delivers tools and guidance essential for improved reliability, increased efficiency and sustainable increased capacity of this complex aging transportation/power network. The research framework integrates water dynamics, infrastructure mechanics, advanced materials, power physics, economics, innovative construction, coastal and riverine processes, automated control and monitoring, remote sensing, operations research, stochastic processes and emerging technologies to create effective solutions in perspective with the multiple demands, requirements and constraints of real world commodity transport and power production problems. Research efforts target navigation channels, locks, jetties, breakwaters, dams and power plants to optimize among life-cycle and reliability trade-offs, assure defensible economic assessment, and provide better investment decision tools for predicting performance and deterioration with time, and scheduling and prioritizing maintenance and repairs balanced with the consequences of delays. FY 2004 accomplishments include:

- Developed elasticity of demand of water transport for Midwest grain using revealed choice approach, a critical part of improving the economics of the Upper Mississippi River Navigation Expansion Study.

- Completion of instrument, survey and econometric analysis estimating the willingness to pay for transportation services on inland waterways for grains, coal and other commodities.

- Completion of a hedonic model explaining processing time through locks in terms of the attributes of the lock and the tow..

- Provided CADET model for predicting underkeel clearance of vessels entering coastal harbors, allowing risk-based predictions of deep draft channel design, optimizing dredging costs and increasing safety.

- Provided guidance for lock approaches, significantly improving lock design, increasing throughput and reducing accidents.

- Provided technical guidelines for seismic stability analysis of concrete gravity dams, increasing dam safety.

- Provided update of current design guidelines for reinforced concrete hydraulic structures resulting in safer, more cost effective structures.

- Developed HarborSym software tool and guidance for quantifying overall engineering and economic risk of deep draft navigation investments

Infrastructure Technology Program (This research program stopped at the end of FY04. Two of the work units will continue in the Flood and Coastal Program beginning FY05 and five of the work units will continue in the Navigation Program beginning FY05).

The Nation must have a sustainable water resources infrastructure fully capable of supporting national requirements. Ensuring expected performance levels requires innovative technologies to extend the useful life of these facilities, reduce life-cycle costs, address hazards and risks in a well engineered and balanced fashion, and minimize rebuilding or replacement, using ecologically low-impact procedures and environmentally responsible materials. The enabling technologies of structural and geotechnical engineering design, geological and earthquake engineering, materials science, and structural risk analysis were developed in this Infrastructure Engineering research area. These technologies provide crosscutting support to all

Corps' Civil Works business programs. FY 2004 accomplishments include:

- Completed modification of SITES Spillway Erosion Analysis with Latin Hypercube Sampling (SSEA+LHS) computer program (Beta Version).

- Completed technical report and user's manual for SSEA+LHS computer program.

- Results from the design for the U-frame monolith using ACI 318-02 are summarized in an ERDC Technical Report and compared to the design case that was based on ACI 318-99. Conclusions about the impact that the changes to ACI 318-02 have on the design of U-frame lock structures are presented.

- Participation in "ASTM-G2 Committee on Friction and Wear" and "ASTM-D20 Committee on Plastics" resulted in two draft ASTM test methodologies. The "Friction and Wear" test procedure has undergone approval through two G2 subcommittee ballots, while the "Creep" test method has undergone one D20 subcommittee ballot.

- Produced report on "Fitness for Service Assessment of Hydraulic Steel Structures", concluded J-integral analysis of corner crack and linear-elastic stress intensity factor analysis of cover plate details, and produced report on "High Cycle Fatigue of Tainter Gate Anchorage".

- Assessed procedures for time-history evaluation and explored dynamic amplification characteristics of seismic stability of concrete gravity dams. Developed CDAS (Concrete Dam Analysis System), and evaluated procedures for performance evaluation of concrete gravity dams based on linear and nonlinear analyses. Performed the following related to reinforced intake towers: identified reinforcement-rupture failure modes; evaluated soil-structure interaction effects; evaluated multiple-support excitation effects; and developed performance-based analysis procedures for seismic evaluation of intake towers.

- Developed guides for use of stone-hardening chemicals for purposes of restoring structural strength to concrete damaged by frost action.

- Developed procedures for analyzing embankment dams on liquefiable foundations to determine dynamic behavior and densification remediation.

- Develop mathematical tension / corrosion prediction models for tainter gate tendon rods.

- Developed simple methods used to estimate the limit-state axial load capacity of spillway invert slabs.

Flood and Coastal Research Area

To carry out its "Flood and Coastal Storm Damage Reduction" mission, the Corps of Engineers is responsible for more than 600 dams, operates over 400 major lakes and reservoirs, maintains 8,500 miles of levees, and has over 100 coastal storm-damage reduction and related projects. Flooding that occurs in the United States costs about $4 billion annually. Despite all efforts, annual damages in the flood plain continue to rise due to continued urban development. In addition, the 2000 census showed that more than 50% of the US population lives within 50 miles of a coast and is vulnerable to dangerous coastal storms and costly flooding. Consequently, over the past several years, Federal shore protection expenditures increased to more than $100,000,000 per year.

The Corps manages existing water resources projects around the country to maintain a flood-protection infrastructure for the public's welfare. Simultaneously, the Corps balances requirements for hydropower, water supply, environmental stewardship, and recreation. As enabling technologies are developed, the Corps must upgrade and improve water resource projects; the Corps must have the most advanced capability to assess the risk of alternative operational scenarios; and the Corps is expected to apply robust, reliable, and comprehensive capabilities to assess the economic and environmental effects of alternative plans for projects and to select the most balanced and sustainable solutions. R&D delivers efficient and effective capabilities to plan, design, construct, operate, maintain, and upgrade water resources projects in all

climates and settings, from warm to ice-affected, and from inland to coastal. Capabilities to prevent loss of life, minimize property damage, and reduce the life-cycle costs of projects are critical. The capabilities include advanced processes and design models, economic models and decision support software, infrastructure condition and risk assessment tools, infrastructure design guidance, innovative operation and maintenance technologies, flood-alert instrumentation and expedient emergency response capabilities, and the capability to take advantage of new real-time data sources (e.g. precipitation radar) to accurately forecast real-time flow and stages. FY 2004 accomplishments include:

- Advanced and enhanced HEC-RAS, the Corps' premier one-dimensional river hydraulics model to simulate grounded ice-jams, sediment transport and morphology changes.

- Advanced and enhanced the Corps Water Management System that supports water resources project operation by implementing a continuous forecast capability, upgraded snow hydrology, and improved reservoir system simulations (for hydropower pumpback storage, water accounting, and period of record analyses).

- Channel & Dam infrastructure stability research yielded advanced guidance for siting grade-control structures, and initial streambank protection designs to improve flood channel design and stream restoration efforts.

- Developed enhanced capabilities for erosion assessment of unlined rock-surface spillways and channels, estimating piping & seepage through dams, and seismic evaluation of intake/outlet structures to ensure life-safety in earthquakes.

- National investment in water resources project improvements and new designs require risk and uncertainty analyses for alternative solutions. The Corps flood damage and impact assessment software was upgraded to include risk and uncertainty in its formulation, and risk-assessment tools for the Corps' water resources projects were enhanced.

- Cold climates cause severe ice damage to structures and their operational capabilities. Ice jams can create channel overflows and flooding. The Corps improved the Ice-Jam Database and added rapid web-based mapping capability, and risk-based ice control analysis and design guidance was developed. New technologies for ice detection were developed.

- Conducted a workshop on Dam Safety Portfolio Risk Assessment Framework (for Dist/Div, 25 attendees)

- Developed prototype dam safety portfolio risk assessment software toolbox portal.

- Developed prototype dam safety portfolio risk assessment screening tool.

- Completed workshop on the application of probabilistic spillway erosion (for Dist/Div, 25 attendees)

- Held a seminar on dam safety portfolio risk assessment (for HQUSACE, 35 attendees)

- Completed a draft ETL for dam safety portfolio risk assessment screening procedure

Environmental Restoration Research Area

Ecosystem Restoration is a growing focus of the Corps Civil Works program, ranging from large-scale activities such as the Everglades, to small local wetlands restorations. In addition, the Corps carries out environmental and natural resource management and restoration activities on more than 11 million acres of land and water resources. The broad scope of these environmental activities, as well as the frequent changes to the legislative mandates that govern them, demand sound research for expanding technological advances to address these critical needs. The Environmental Restoration research area is a R&D initiative for this purpose. The goal is to provide Corps field personnel with cost-effective/innovative technologies for project planning, design, engineering, operation, and regulatory activities. Product lines include: Environmental Impact Assessment, Ecosystem Restoration and Environmental Stewardship and Management. Environmental studies related to

Cross-cutting R&D (i.e., Geospatial, Economics, and Risk) are also addressed. Products are concise, how-to guidance documents that provide rapid/low-cost technologies and methods for high priority field needs. This technology is critical to the success of the Corps' Continuing Authorities Program (CAP) as well as larger GI-funded projects. FY 2004 accomplishments include:

- Provided guidelines for the planning and execution of dam removal projects to protect/enhance our Nation's streams and rivers ecosystems. Continued work on innovative technologies for restoration of submerged aquatic vegetation
- Developed a multi-functional approach to riparian and in-stream restoration techniques that improves species protection as well as environmental quality
- Provided guidelines for improved natural resource inventory techniques for Corps lands to insure their preservation
- Established guidelines for innovative tree planting techniques in arid/semi-arid riparian regions
- Developed community index models for Coastal and Riparian ecosystems
- Identified benefits of levee gapping on fish communities and sediment accumulation for Coastal wetlands
- Produced regional guide books for depressional, riverine, and coastal wetlands

System-Wide Water Resources

The goal of the System-Wide Water Resources research area is to support all business lines of the Corps of Engineers and its partners by providing the capabilities to balance human development activities with the natural system in a sustainable manner through regional management and restoration of the Nation's water resources over broad temporal and spatial scales. This research area was matured during FY 2004 as several strategically oriented watershed and regional programs were consolidated into a single initiative. These included the Regional Sediment Management, Technologies and Operational Innovations for Urban Watershed Networks (TOWNS), System-wide Modeling, Assessment, and Restoration Technologies (SMART), Geospatial Technologies, and Common Delivery Framework programs.

The capabilities provided herein include science-based water resource management methodologies, implementation guidance, computational frameworks and technologies, and decision support. These capabilities are being built from sound scientific principles reflecting an improved understanding of inter-relationships among key system attributes such as hydrology, geomorphology, chemistry, ecology, and socioeconomic. Capabilities will be served via a seamless, integrated architecture allowing projects to be considered at multiple-scales during project planning, design, construction, operation and maintenance.

FY 2004 accomplishments include:

- Completed a detailed review of regional sediment management strategies developed for large system-scale projects within the Corps.
- Developed novel technologies for sediment measurement and monitoring for use at both local and regional scales.
- Completed basic regional sediment processes research to improve modeling capabilities, engineering guidance, and understanding of sediment transport in natural systems.
- Developed preliminary algorithms for biological response to sediment transport in river, reservoir, and estuarine environments.
- Conducted demonstrations of prototype coupled hydrodynamic, water quality, and ecological response models for watershed, riverine, reservoir, and estuarine systems.
- Developed a corporate environmental software package to analyze geospatial and statistical data critical for modeling, managing, sustaining and restoring watersheds.
- Developed web service to more effectively deliver data for programmatic consumption

by Science & Engineering (S&E) models and/or decision support tools.

- Analyzed remote sensing methods to improve snow and ground water mapping techniques in all-weather, day-night conditions and new tools to incorporate the methods in Corps water resource projects.

- Compiled and reviewed assessment and predictive tools (numerical models) for system-wide applications.

- Established a common file format and created a first generation conceptual sediment model to assist managers in selecting optimal or near-optimal sediment management decision scenarios.

Other R&D Programs

Scientific and Technical Information Centers

Five information analysis centers located at the U. S. Army Engineer Research and Development Center provide the major interface between the Corps of Engineers and the public and private sectors to gather and disseminate information as required by PL 99-802, Federal Technology Transfer Act of 1986. The function of each center is to acquire, examine, evaluate, summarize, and disseminate newly published scientific and technical information generated within the Corp of Engineers and other activities in the U.S. and abroad.

The Coastal Engineering Information Analysis Center focuses on wave data and predictions, shore processes, inlet dynamics, navigation channels and structures, harbors, and coastal construction. The Cold Regions Engineering Information Analysis Center focuses on ice engineering, meteorology, climatology, geophysics, geology, remote sensing, and environmental engineering. The Concrete Technology Information Analysis Center focuses on cements, concrete, aggregates, concrete construction, concrete repair and rehabilitation technology. The Hydraulic Engineering Information Analysis Center focuses on Hydraulic, hydrologic, water resources, and sedimentation of streams, rivers, waterways, reservoirs and natural impoundments; estuaries, inland and coastal groundwater; fishery systems; and hydraulic structures of all types. The Soil Mechanics Information Analysis Center focuses on embankment and foundation engineering, earthquake engineering, engineering geology, and rock mechanics.

Public Law 99-802, Federal Technology Transfer Act of 1986, requires technology transfer from Federal agencies to the private sector. In addition, both the Department of Defense and the Department of the Army have objectives of supporting the information needs of engineers and scientists and eliminating unnecessary duplication of R&D. The specified information centers, supported by their host laboratories, critically evaluate and summarize the technical validity and merits of published and unpublished research and technical publications on design, construction, or other technology utilization. User communities have been well established and distribution lists for technology transfer are continuously updated. Electronic media including the World Wide Web are used where appropriate. The effectiveness of activities and services is evaluated on a continuing basis, and technology transfer products and methodology are revised when appropriate. Accomplishments in FY 2004 include:

The Corps is making major use of the World Wide Web (WWW) for technology transfer. The WWW is widely accessible by both the public and private sectors and provides rapid transfer, at significant cost savings, of technical data, bulletins, general information on ongoing studies, technical notes, and ultimately technical reports. The information centers and their host laboratories are now maintaining WWW homepages with links to other related homepages. Recent establishment of internal networks, as well as a Corps-wide network, along with connection to the Internet, have provided a major leap forward in communications at a significant reduction in transmittal costs. Several thousand technical inquiries are received annually, with the Internet playing an increasingly major role. Inquiries are received from Federal, state, and local government activities, universities, private sector engineers and scientists, and concerned citizens.

Coastal Field Data Collection

The nationwide program is designed to systematically measure, analyze and assemble information required to accomplish the Corps mission in coastal navigation, storm damage reduction, and evaluation of harbor entrance impacts on adjacent shores. The data directly support project comprehensive regional and local planning, research, design, construction, operation, and maintenance. The program is organized into seven sub-items, all related to field data: (1) Wave Information Studies;

(2) Field Wave Gauging; (3) Field Research Facility Measurements; (4) Participation in the National Ocean Partnership (NOPP) and its coastal observing effort, (5) Southern California Beach Measurement Program, (6) Monitoring for Typhoon and Hurricane impacts in the Pacific and Caribbean Islands, and (7) Evaluation of Shore Protection Projects.

Wave Information Studies. Numerical simulation techniques are used to estimate directional wave environments from weather information for all the Great Lakes and the nations ocean coastline. Most historic wave gauge data are non-directional; eventually hindcast data will provide 20 years of spatially and temporally consistent directional wave statistics. This information is paramount to the functional/structural design and economic evaluation of coastal navigation projects and of fundamental use to coastal Regional Sediment Management (RSM) studies. Additionally, detailed wind information is produced. These data are made available to Corps of Engineers Districts via interactive web access. Data users are also provided with statistical representations desired of waves.

Field Wave Gauging. High-quality wave data are needed to predict harbor shoaling, harbor oscillation, jetty stabilization, etc. These data are imperative for operational guidance of dredging, navigation, maintenance, emergency operations, etc. Gauging efforts are coordinated with the National Oceanic and Atmospheric Administration (NOAA), and with the Scripps Institution of Oceanography through the State of California (http://cdip.ucsd.edu). These data will become part of the Corps' contribution to the interagency effort for an Integrated Ocean Observation System (IOOS) under the National Ocean Partnership Program (NOPP). Upon acquisition, the data are analyzed and made available in real-time to CE engineers, planners, and managers along with the general public via the Internet. Cooperative agreements for the collection of wave data have been executed with the states of California, Alaska, Florida, Hawaii, Washington, Texas, and Virginia. These agreements provide a mechanism for other Federal, state, and local agencies to cooperate in the expansion of the program and the collection of coastal data.

Field Research Facility Measurements. Critical to measuring, analyzing and providing useful coastal data products for the CE Districts is the collection of intensive, long-term, high-resolution data for improving project design and reducing costs. The Field Research Facility (FRF) at Duck, North Carolina (http://frf.usace.army.mil/), is a unique real-world experimental facility that incorporates high-resolution instruments with comprehensive suites of environmental sensors to provide wave, current, meteorological, bathymetric, and topographic data.

Participation in the National Ocean Observing Program. This task objective supports CE's participation in the National Ocean Partnership Program (NOPP, http://www.nopp.org). This interagency program involves 15 other Federal Agencies (Navy, NASA, NSF, NOAA, USGS, DoE, EPA, DARPA, DoS, USCG, ONR, OSTP, Homeland Security, MMS, OMB) with the objective of advancing ocean research through partnerships. The Corps' is also a signature member of Ocean.US, the NOPP office established to organize and promote the national Integrated Ocean Observing System (IOOS).

Southern California Beach Processes Study (SCPBS). Planning for Regional Sediment Management (RSM) activities (shoreline protection, beach maintenance, coastal inlet dredging and related engineering activities) requires an understanding of the coastal processes and sediment budget over regions extending tens of miles up and down coast. In this task the coastal processes will be monitored along a 55-mile-long littoral cell extending from Dana Point to Point La Jolla in Southern California (http://cdip.ucsd.edu/SCBPS/homepage.shtml). This unique populous region is characterized by narrow continental shelves, swell-dominated wave climates and cliff-backed beaches. Monitoring will involve airborne LIDAR and video techniques for determining seasonal beach and cliff variation in this region combined with wave measurements and modeling to quantify the impact of coastal storms on beach and cliff changes over multiple years. Because of the comprehensive nature of the monitoring, these data will be used to develop an analysis of the potential risk associated with use of a less-comprehensive monitoring program for application to other regions of the country.

Pacific Islands Land Ocean Typhoon (PILOT) Experiment. This task seeks to collect cross-island wind, wave, wave and water level data documenting hurricane and typhoon passage in the Pacific and Caribbean islands. Tropical cyclones affect islands differently than the continental United States. Consequently, existing forecast models, intensity scales, and design tools for cyclones are inappropriate or unproven for use in the islands. The objective of this effort is to provide the quantity and quality of timely data required to more accurately document characteristics and effects of episodic cyclonic activity in the islands, which specifically

address needs developed by the Corps' Island Task Force. Measurements will most likely be made on the Island of Guam because of its likelihood of a Typhoon passage. Supporting measurements will also be made in Hawaii and will take advantage of the expertise available in tasks 1-4 above.

Performance of Shore Protection Projects. The objective of this task is to improve future shore protection projects through evaluating the performance of existing projects, and through augmenting the field monitoring programs of selected new projects. Existing projects will be examined for their physical, economic, and benefit performance. In particular, the success in the use of modern modeling tools and monitoring techniques for developing shore protection project designs will be examined. Evaluation tools and design improvement recommendations will be developed. Project summaries including surveys, specs, and performance data will be collected and made available via the Internet. Standardized web templates for migrating project information to the web will be developed. This effort will maximize the use of existing project performance data and directly responds to district requirements for tools and techniques to analyze performance data.

Remote Sensing/GIS Center

The Remote Sensing/GIS Center is the Corps' Center of Expertise for Civil Works Remote Sensing and GIS technologies, providing mission essential support as part of the new USACE 2012 organization. Through centralized management of this function, the Center provides cost-effective support through technology transfer and applications development for Corps mission responsibilities in all business practice areas: navigation, flood and coastal storm damage reduction, hydropower, regulatory, environment, emergency management, recreation, water supply, and work for others. Continuing interaction with other researchers and practitioners throughout the Corps, government, the private sector, and academia assures that state-of-the-art and state-of-the-practice knowledge of evolving trends that are important are available for the Corps and that duplication of effort is avoided.

The Center develops approaches for the integration of data from the disparate sources necessary for regional sediment management, basin studies, water control, land and water resource management, support to emergency management, and compliance with the attendant environmental regulations and related policies. The Center maintains cognizance of state-of-the-art sensors, data collection, analysis, and storage systems, commercial software, and bridging software that integrates these and operational technologies into the Corps divisions, districts, and other agencies' activities. Technology is transferred through telephone and short no-cost assistance to the field. The existence of the Center ensures that the necessary support can be rapidly directed toward solving operational problems that require specialized expertise. The PROSPECT training program in remote sensing and GIS, managed by Center staff, provides another avenue for the transfer of knowledge to those who are, or soon will be, using these technologies. Training also is conducted in the field, through workshops and conferences. White papers, pilot projects, Corps and other publications, including Engineering Letters, Circulars, and Manuals, and the Internet, also are used to transfer procedures and lessons learned to end users.

Accomplishments in FY 2004 include:

- As the Center of Expertise, served as key resource and technology point of contact for the Corps of Engineers for Civil Works remote sensing and GIS.
- Acquired and distributed enterprise geospatial data to all Corps entities.
- Assisted with establishing the Corps' Geospatial Community of Practice (COP), and provided technical support.
- Continued technology transfer through training courses, briefings, technical papers, technical demonstrations, pilot programs, and conferences.
- Provided leadership and technical support to strategic and enterprise USACE geospatial initiatives: Informatics Strategic Plan Program Development Team and Plan co-author; Common Delivery Format team member; Science and Engineering Technology Tools Program Development Team and subteam leader; Readiness XXI Technology Transfer Program Development Team; Geospatial Operations and Maintenance Business Interlink (gORM) team member; and Hydrology and

Hydraulics modeling software development and support team member.

- Developed and enhanced national geospatial data viewers for Corps' programs.
- Major update of the PROSPECT Introduction to GIS course.
- Provided technical support to Corps District offices for the development of implementation plans for Geospatial data management including development of enterprise geospatial data approaches.
- Supported one-stop service requests from Corps districts and divisions.
- Developed and distributed national geospatial data coverages for emergency management and other Corps business practice applications.
- Member of the CADD/GIS Technology Center's advisory support team.
- Managed and provided administrative support of the Civil Works Geospatial Research and Development Program.
- Participated in development of a redefined approach to Civil Works R&D to better meet the Corps' strategic requirements.
- Sponsored and participated in program development of national and international remote sensing and GIS conferences.
- Completed a new version of the Corps' Remote Sensing Manual that includes high resolution satellites and hyperspectral and digital airborne systems.
- Maintained a website to support the transfer of technology from the Civil Geospatial R&D Program to the field.
- Provided civil funds to the CCIO as needed to support field imagery requirements.

Automated Information Systems Support - Tri-Service CADD/GIS Technology Center

This effort provides technical support to engineers and scientists utilizing CADD, GIS, and facility management technologies in the planning, design, construction, operation and maintenance of Corps projects. In 1992, the former Army Corps of Engineers' Computer Aided Design and Drafting (CADD) Center, located in the Army Engineer Waterways Experiment Station (WES), was expanded to an Army, Navy, Air Force (Tri-Service) center, including the addition of Geographic Information Systems (GIS) technology, by a joint agreement between the Corps, the Naval Facilities Engineering Command, and the Air Force Civil Engineer. Its purpose was to reduce duplication of effort between the three services in the management of CADD/GIS technology for facilities and environmental engineering. Since that time, the Defense Logistics Agency (DLA), the General Services Administration (GSA), USGS, FBI, Smithsonian Institution, National Capital Planning Commission, U.S. Marine Corps, U.S. Coast Guard, National Institute of Building Sciences, NIMA, EPA, and NASA have joined this effort. As a result, this Center is a multi-agency vehicle to set standards, coordinate CADD/GIS systems uses, promote system integration, support centralized acquisition, and provide assistance for the installation, training, operation, and maintenance of CADD/GIS systems within the DoD facilities and environmental communities, including the Corps districts. All Corps districts that use CADD and GIS in mapping, planning, real estate, design, construction, operations, maintenance, and homeland defense and readiness benefit from the Center's efforts. Accomplishments in FY 2004 include:

- Release 2.3 of the A/E/C CADD Standard (both document and software tools) was released on CD-ROM and via the web. This released was distributed by several software vendors as part of their application (e.g. ProSoft). Software updates included: (1) the File Converter, which can convert a CADD file that conforms to the former Corps EM 1110-1-1807 CADD Standard to Release 2.1 of the A/E/C CADD Standard, and (2) the File Manager, which assists users in naming files so they are compliant with Release 2.1 file naming conventions. Implementation software for both MicroStation and AutoCAD were released. Several training classes were taught.

- The GIS Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE) Release 2.4 was completed. The SDSFIE included continued development of the GIS data standards for Civil Works activities, which provide a common data format for the development of GIS on civil works projects, thereby cutting costs and allowing sharing of data sets among government agencies and the private sector. Homeland Security data sets and symbology sets were completed in support of USGS and NIMA to analyze data more quickly and facilitate data sharing and upward reporting. Electronic tools were developed to facilitate the construction of GIS datasets for various GIS vendor products (e.g. Intergraph's GeoMedia and ESRI's ArcGIS).Several training courses on implementation and use of GIS data standards were conducted.

- Enhanced the Electronic Bid Solicitations (EBS) program by establishing a Central Listing of all bid solicitations from DoD agencies and continued to work with The Bluebook company to make solicitations available to a wider audience. The Center instituted an EBS hosting service at WES to support those offices/agencies lacking the expertise to develop their own. EBS services for the Corps were established at the Center under the name Electronic Contract Solicitation.

- Release 2.4 of the facility management standard (FMSFIE) was completed and distributed. Continued the incorporation of "legal" reporting requirements (data) necessary for Army Corps of Engineers, Army, Air Force, Navy, Coast Guard, GSA, and OSD.

Aquatic Nuisance Species Research

The Aquatic Nuisance Species Research Program (ANSRP) is an expansion of the Zebra Mussel Research Program (ZMRP). This expanded program addresses all invasive aquatic animal species. Invasive species in general cost the public over $137 billion annually. Zebra mussels alone cost the public over $1B annually. It is estimated that over 100 nuisance species are introduced into U.S. waters annually which can impact facility operations and threaten valued natural resources. The Corps is responsible for the construction, operation, and maintenance of navigable waters and the resources associated with them. Methods of prevention and more effective, inexpensive methods of control of invasive species must be developed to prevent impacts to public facilities and protect valuable natural resources.

Prevention methodology focusing on dispersal barrier technology will be investigated. The development of strategies to apply control methods involves engineering design, operations, and maintenance of facilities and structures. Control strategies are being developed for (a) navigation structures; (b) hydropower and other utilities; (c) vessels and dredges; and (d) water treatment, irrigation, and other water control structures. Methods to reduce invasive species impacts to threatened and endangered species and restore natural habitat will be investigated. Due to the introduction of the Northern Snakehead Fish and West Nile Virus the Corps has experienced a significant increase in the number of field assistance requests at our operating projects. Numerous dredged material disposal areas in the Atlantic, Gulf coast and Great Lakes region have mosquito abatement programs. Due to the introduction of the West Nile Virus local communities want greater assurances that mosquito populations at our disposal sites are controlled to the maximum extent practicable. Following introduction of the Northern Snakehead Fish a number of Corps reservoir projects have had to take interdiction measures to prevent their introduction.

Accomplishments in FY 2004 include:

- Provided guidance on biological/ecological effects of aquatic nuisance species in marine and estuarine environments throughout the US

- Provided how-to guidance to evaluate susceptibility of different habitats, ecosystem components, and man-made facilities to aquatic nuisance species infestation with recommended control methods.

- Provided hybrid internet/computer-based information system that will allow users easy access to detailed/summary information on numerous ANS species.

- Developed decision-making ANS assessment technologies to determine threat, early detection, monitoring strategies, management protocols, and exclusion protocols.

- Provided guidance on impacts of zebra mussels on native fishes

Coastal Inlets Research Program

Records demonstrate that the Corps will expend an estimated $8 to $10 billion over the next 25 years at the more than 150 tidal inlets with existing Federal navigation projects to maintain, modify, and create navigation channels and structures, and to mitigate damages to adjacent beaches. In addition, the national "2020" plan for deeper and wider channels to accommodate the next class of vessels brings great uncertainty in prediction of maintenance requirements. Political, engineering, and demographic factors may increase costs. The public perception, right or wrong, that Federal activities at inlets cause adverse response at adjacent beaches may require additional, expensive mitigation. Public sensitivity to current maintenance practices, where dredged material is placed in offshore disposal areas, may result in requirements for more nearshore placements of maintenance materials to benefit adjacent beaches. Inlets are the primary conduits for the transport of environmental constituents between bays and the open ocean, and the Corps may be constrained from performing present activities unless it can make accurate predictions of inlet response, and thus environmental response, to such activities.

The Coastal Inlets Research Program is a fixed-length program to increase Corps capabilities to cost-effectively design and maintain the more than 150 inlet projects that comprise the bulk of coastal operations and maintenance (O&M) expenditures. Because of their complex nature, the behavior of inlets is poorly understood. This has resulted in the Corps spending more of its O&M budget than necessary to maintain inlet projects. The Coastal Inlets Research Program will study functional aspects of inlets such as their short- and long-term behavior and their response to waves, tides, currents, and man-made changes, given their geologic makeup. As inlet behavior becomes better understood, sophisticated tools for management of inlets for navigation projects, such as models and empirical relationships, will become available. These new tools will lead to more efficient, cost effective designs that will reduce O&M requirements and, consequently, costs.

Accomplishments in FY 2004 include:

- Completed R&D and held a tech-transfer workshop (50 attendees) for the Steering Module in the SMS interface, allowing automated coupling of tidal circulation (ADCIRC, M2D) and wave models (STWAVE) to account for the wave-current and current-wave interactions. The Steering Module plays a central role for integrated modeling for field use to calculate tidal circulation, waves (with wave-current interaction), and sediment transport at high resolution. This modeling system allows assessment of jetty modifications, channel infilling, and channel alignment for reduction of dredging and improved navigation safety. Successful evaluations were conducted at Shinnecock Inlet, NY; Grays Harbor, WA; Willapa Bay, WA; and Ocean City Inlet, MD.

- Extended and completed a physical-processes based automated sediment budget system for management of inlets and adjacent beaches to include GIS features and connections to regional sediment management methodologies. The extended system was released Corps wide and to consulting companies and academia. Held three workshops to transfer the technology.

- Extended the Reservoir Model for calculating volume change of inlet features such as ebb shoals and flood shoals, and validated the model at Ocean City Inlet, MD, and Shinnecock Inlet, NY. This technology allowed predictions to be made in support of Corps navigation projects that previously were beyond capability, accounting for the long-term (order of 100 years) evolution of inlets. Collaborated with the Regional Sediment Management Program in incorporating the Reservoir Model in its coastal modeling technology – Cascade.

- Developed circulation models for all of the Great Lakes to validate Coastal Inlets Research Program technology for calculating wind-forced seiching. Collaborated with the Buffalo, Chicago, and

Detroit Districts to validate the modeling system for the Great Lakes.

- Developed and verified a numerical model to predict scour for regions characterized by local flow curvature, flow separation, entrainment, and flow interaction with inlet structures. Applied to Matagorda Ship Channel, TX; Ventura Harbor, CA; and Shinnecock Inlet, NY. Model is released to public through the worldwide web.

- Updated web-based tutorial and handbook on coastal inlets called "Inlets Online" that addresses needs from the professional engineering and science level to college and high school education. Aerial photograph collection includes historic (from 1930's) to most recently acquired aerial photography around the Corps.

- Developed a neural-network based data-gap filling utility with predictive capability in support of field measurement and long-term simulations of water level and current.

- Conducted two major tech-transfer workshops in association with national and international conferences (25-50 attendees) and at ERDC-CHL in association with the Coastal Engineering Manual course (50 attendees). Conducted direct training at several Corps Districts and consulting companies under contract with Corps Districts.

- Supported Corps districts in addressing concerns on national applicability at specific inlets. These included implementation of a new jetty termination concept at Grays Harbor, WA; sand management prediction at Shinnecock Inlet, NY, for which periodic mining of the flood shoal was demonstrated to be a competitive and favorable alternative for the total inlet sediment system; Ocean City Inlet, MD, involving channel deepening, jetty rehabilitation, and sand bypassing to Assateague Island (National Park Service); and modification of deposition basin design with weir jetty at Mouth of Colorado River, TX.

Dredging Operations and Environmental Research (DOER) Program

The DOER Program is an integral and highly beneficial component of the Corps navigation dredging and environmental protection missions. Dredging and disposal must be accomplished within a climate of increased dredging workload, fewer placement sites, environmental constraints, and decreasing fiscal and manpower resources. Balancing environmental protection with critical economic needs while accomplishing dredging activities is a major challenge. The program has validated innovative technologies for high profile contaminants and developed risk based assessments that will significantly reduce testing costs at virtually all harbors. Methods for reclamation and reuse of contaminated sediments from upland disposal areas for beneficial purposes as well as increased capacity are key components of the program that will result in tremendous savings.

Major focus areas of DOER include, (1) innovative technologies research, (2) environmental resource protection, (3) dredged material management, and (4) risk research. Accomplishments in FY 2004 include:

Innovative Technologies: Transferred technology to a wide body of stakeholders that addressed operational, economic, and environmental components of the Corps dredging program in full coordination and cooperation with other appropriate agencies and offices such as: Environmental Protection Agency, National Marine Fisheries Service, US Fish and Wildlife Service, American Association of Port Authorities (AAPA) and state natural resource managers. Aggressive technology transfer was conducted through multiple media and rapid technology application that ensured that research products were integrated into decision making at Corps projects and were made available to port authorities and other navigation project stakeholders, (e.g.,. water injection dredging, mechanical dewatering, reactive barrier capping, real time dredging management reporting, initiate Decision Support System, and fluid mud definition).

Environmental Resource Protection: Identified, evaluated and developed innovative tools, databases and software, equipment, and technology to improve the design, operation, and management of Corps maintained navigation projects. Addressed problematic environmental resource issues, such as environmental windows or threatened and endangered species, using a combination of

innovative engineering and scientific approaches (e.g., endangered fish assessment/protection, management for bird habitat, risk based approach to endangered/protected species management, T&E website – sea turtles, sedimentation impacts to habitat, submerged aquatic vegetation habitat protection, and environmental "best management practices").

Dredged Material Management: Developed dredged material handling, transport, and placement options, which are operationally efficient, environmentally sound and cost effective (e.g., GIS dredged material management system, WEB-based assessment tools, suspended sediment tracking model, sediment stability screening tools predict resuspension due to dredging, confined disposal management technology, and beneficial uses of dredged material).

Risk: Applied a comparative risk-based framework in the assessment and management of contaminated dredged material and to develop logical decision support tolls that quantify uncertainty and facilitate efficient decision making (e.g., dissolved contaminant estimation and assessment, contaminant bio-availability, CDF contaminant loss model, contaminant micromethod of analysis, volatile contaminant losses from sediments, field validation of chronic/sublethal testing, risk assessment decision support tool, and risk management decision analysis program.

Dredging Operations Technical Support (DOTS) Program

Maintenance of the nation's navigation projects requires compliance with numerous complex environmental statutes and Presidential Executive Orders. The Dredging Operations Technical Support (DOTS) Program fosters the "one-door-to-the-Corps" concept by providing comprehensive and interdisciplinary technology transfer, technology application, and training essential to all stakeholders involved in Corps navigational dredging projects. DOTS is managed within a centralized program to maximize cost effectiveness and expeditiously implement National policies, laws, and complex technical requirements on a consistent basis. The DOTS Program focuses on application of state-of-the-art technology and research results to field problems. Emerging environmental concerns as well as advances in scientific technology often cause uncertainty in administration of the Corps' navigational dredging program. The DOTS program's technology transfer function provides access to an extensive, up-to-date, consistent technology base and facilitates rapid, proactive responses to technical issues as they emerge. This fosters networking and solutions to common problems confronting the navigation dredging community. Short-term work efforts to address generic Corps-wide technical problems encountered during maintenance of navigable waterways and infrastructure are major features of the DOTS Program. Technology transfer and demonstration of new and emerging techniques with potentially high returns on investment for management of Corps navigation maintenance projects are also important DOTS activities. By disseminating knowledge of new research and development efforts to field offices constrained by staff reductions, the DOTS Program will continue to perform a critical technology transfer role in support of all O&M navigation projects.

Accomplishments in FY 2004 include:

- The DOTS program successfully met all of its goals established for technical support, technology transfer, and outreach.
- Technical questions, from Federal and state agencies and private concerns dealing with implementation of the inland and ocean testing manuals, continued to be addressed.
- As mandated by the 1972 London Convention, the DOTS program reports ocean dumping activities to the EPA and the International Maritime Organization.
- The program has conducted 21 sediment management seminars since 1991 that have been attended by over 4,800 personnel from Corps districts, federal, state, and local agencies, industry, and environmental protection groups. Instruction focused on state-of-the-science techniques in regulating, testing, and managing dredged material.
- The program also continued to provide specific guidance for the assessment and protection of threatened and endangered species associated with navigation projects. A joint Corps/EPA task force made significant progress toward formulation of a combined, generic ocean and inland disposal implementation manual. This effort fosters consistency in dredged material testing and management between the Clean Water and

Marine Protection, Research and Sanctuaries Acts. This builds upon and serves as a companion to the completed final version of the Upland Testing Manual.

- Expansion, maintenance and updating of several web-based databases provided enhanced access to important sources of information, such as the Environmental Residue and Effects Database (ERED), which continued to be critical for successful implementation of the CE/EPA ocean and inland testing manuals for dredged material disposal. New databases that extend accessibility to related resources, including upland plant toxicology, and tools for risk assessment applications were brought online.

- The DOTS Program continues to be an exceptionally successful conduit for navigation and dredging-related information, as evidenced by the distribution of thousands of technical manuals, bulletins, technical notes and reports currently found on the DOTS website (www.wes.army.mil/el/dots). The DOTS website provides a comprehensive information retrieval system for all relevant products related to regulating, maintaining, and managing the nation's navigable waterways.

Inland Waterway Navigation Charts

This effort provides Corps' Electronic Navigational Chart (ENC) data for all inland waterways and other federal navigation channels maintained by the Corps to be used by commercial Electronic Chart Systems (ECS), which, when combined with the existing Differential Global Positioning System (DGPS), will improve the safety and efficiency of marine navigation in both inland and coastal waterways of the United States. On inland waterways, the Corps will collect more accurate survey and mapping data than is currently on its paper charts, and produce Inland Electronic Navigation Charts (IENCs) in accordance with navigation users and ECS vendors. When combined in the commercial ECS will greatly improve the safety and efficiency of navigation. This will allow safe navigation through bridge openings during fog and other bad weather conditions as well as during heavy traffic situations, and provide an accurate display for other systems such as radar and Automatic Identification Systems. The Corps will use the S-57 international data format, which is consistent with electronic chart products produced by the National Oceanic and Atmospheric Administration (NOAA), and the chart products produced by the two agencies will be coordinated for compatibility in adjoining areas. The Corps will also coordinate with the U.S. Coast Guard for aids to navigation information and collaboration rules for chart carriage by waterway users. In coastal and Great Lakes areas, the Corps will produce standardized channel conditions chart products that will provide consistent and reliable information to NOAA for chart updates, in accordance with Water Resources Development Act of 2000, Section 558. Similar channel chart products will be provided to navigation users, and these coastal and Great Lakes channel condition chart products will also follow the S-57 format. Such ENC development and publication activities are in accordance with National Transportation Safety Board recommendations to the Corps, and subsequent commitments made by the Chief of Engineers.

Accomplishments in FY 2004 include:

- New chart development – 1499 river miles: Began development of chart coverage for the Ten-Tom and Illinois Waterway, and Cumberland, Tennessee, and Arkansas Rivers;

- Chart revisions and updates – 2,600 river miles: Published updated chart cells for the Mississippi, Ohio, Red, and Atchafalaya Rivers;

- Performed tests and demonstrations aboard industry vessels and

- Continued collaboration with European Inland ECDIS for coordinating chart data standards.

Monitoring of Completed Navigation Projects

The Corps operates and maintains more than 800 navigation projects encompassing more than 25,000 miles of waterways. The purpose of this monitoring program is to identify the best navigation project practices and use them to improve all navigation projects' performance. Optimizing projects'

performance requires that they be monitored, evaluated against preconstruction projections and present needs, and the lessons learned translated into proactive management guidance for Corps Districts. Information gained from monitoring navigation projects, including changes in sediment transport, water levels, currents, waves, flushing, river flows and other hydraulic phenomena with associated environmental impacts, will be used to verify design expectations, determine benefits, and identify operational and maintenance efficiencies. Information collected from monitored navigation projects can improve projects' performance and optimize opportunities for environmental enhancement. Information collected and analyzed on a national basis documents successful designs, disseminates lessons learned on projects with problems, and provides upgraded field guidance that will help reduce life-cycle costs on a national scale.

Selective and intensive monitoring of Civil Works navigation projects is executed to acquire information to improve project purpose attainment, design procedures, construction methods, and operation and maintenance (O&M) techniques. Both shallow- and deep-draft navigation projects located in rivers, reservoirs, lakes, estuaries, and the coastal zone are included in this program. Projects that will potentially provide maximum life-cycle cost savings are identified and those that best address high-priority cost savings are selected for monitoring and evaluation. Monitoring plans are developed jointly by Corps Districts and the US Army Engineer Research and Development Center. They consist of either a comprehensive detailed survey to verify post-construction conditions on a one-time basis or a repetitive collection of field data. The intensive data are analyzed and the results compared to the pre-construction predictions to verify or upgrade existing design guidance for minimizing O&M cost and assuring project benefits. The analyses include structural, topographic, bathymetric, and hydrodynamic responses and intercomparisons of projects when applicable.

Coordination between the Corps and other Federal, state, and local agencies is essential for proper accomplishment of this program. In addition to satisfying Corps' requirements, the data are made available through publications and will be of value to local, State, and other Federal agencies tasked with the development and implementation of regional coastal and inland navigation management policies. Results are communicated to member agencies of the Marine Transportation System (MTS) committees.

Accomplishments in FY 2004 include:

- Published a technical report providing results of periodic inspections of coastal structures previously monitored by the MCNP program.
- Published technical reports on stone degradation of coastal structures located in the Great Lakes, and another on monitoring of tidal inlet improvements at Barnegat Inlet, NJ.
- Published a technical report summarizing lessons learned and providing guidance from monitoring completed navigation projects.
- Coastal and Hydraulics Engineering Technical Notes were published for each work unit in the MCNP program providing interim results of the monitoring efforts.
- The MCNP web site was enhanced and all MCNP publications were made available electronically through the web site.
- A periodic inspection of 42-ton dolosse armor units at the Crescent City Harbor, CA, breakwater was conducted, and monitoring of several additional navigation projects (Tedious Creek, MD; Aguadilla Harbor, PR; Tom Bevill Lock and Dam, AL; Upper Mississippi River training structures at pools 8 and 13; bendway weirs at Greenville Bridge Reach, Mississippi River; ship motions for commercial vessels at Houston Ship Channel, TX, and "pocket wave absorber" effectiveness in the Great Lakes). These projects were nominated by Corps field offices for inclusion in the MCNP program.

Regional Sediment Management Demonstration Program

The Demonstration Program goals are to link the management of authorized Corps projects with one another, leverage data collection and shoreline management activities with other Federal agencies, State and local governments, within the limits of a regional watershed system (including uplands, rivers, estuaries and bays, and the coast). The purpose is to demonstrate short and long term cost savings and

increased economic and environmental benefits of maintaining sediments within their regional system and using sediments to sustain a balanced environment.

Accomplishments in FY 2004 include:

- Mobile District (SAM) completed their 3-year RSM demonstration projects with an estimated cost savings of $9.4 million.

- A demonstration at East Pass was completed in FY 2002 with collaboration with the United States Air Force, and a demonstration at Perdido Pass was completed in FY 2003. Both sites are being monitored to determine benefits to the region. The cooperation among Federal agencies and the collaboration among the three levels of government have been the greatest accomplishments to date.

- Because of the RSM demonstration project data and model results, SAM was able to propose a feasibility study that reduced the study time period from six to three years, and the cost by $2 million.

- SAM completed three Technical Notes giving other Districts guidance for regional sediment management.

- Demonstration Projects are underway in northeast, central, and southwest Florida, New Jersey, New York, the southeast coast of Lake Michigan, north-central Texas, southern California, the Mouth of the Columbia River, and the Upper Columbia River. The New Jersey and New York projects featured collaboration with the US Geological Survey, the Minerals Management Service, the National Ocean Service, and the National Environmental Satellite Data and Information Service in mapping and managing offshore sediment resources as well as nearshore processes. The Lake Michigan project features close coordination and cooperation with the Corps regulatory program and the states of Michigan and Indiana. The southern California project links the efforts of the state and numerous beach communities from Dana Point to Del Mar. The northeastern Florida project links several navigation projects with shore protection projects in conserving sand. The Upper Columbia River demonstration is a team effort with the Yakima Native Americans to propose a plan for regional use of dredged material that is being reviewed by State and Federal Fish and Wildlife agencies.

Water Operations Technical Support (WOTS)

Maintaining the environmental and water management conditions at 562 reservoirs (5,500,000 surface acres), 237 navigation locks, 926 harbors, 75 hydropower projects, and 25,000 miles of inland and coastal waterways impacted by the operation of Corps projects requires compliance with numerous statutes and state standards. Providing the technology and knowledge base necessary to address the general non-project specific environmental and water management needs of project operations can best be accomplished through a comprehensive centralized program that will maximize cost effectiveness, and ensure broad dissemination and implementation of technology and information.

Accomplishments in FY 2004 include:

- Since its inception in FY 1985, WOTS has provided environmental and water management technological solutions to over 1,400 problems identified at projects from every Corps District. The program annually publishes and distributes numerous copies of manuals, bulletins, notes, and reports. WOTS annually conducts specialty workshops, training personnel on the latest environmental and water management techniques.

- WOTS successfully responded to 50 direct technical assistance requests from 31 Corps Districts, conducted 5 technology demonstration efforts to verify management strategies and techniques, conducted 7 training workshops on environmental and water management techniques, and prepared 12 technical publications for distribution to the field.

- A continual endeavor of the WOTS program is coordination with water management and environmental elements of other Federal agencies such as the Environmental Protection Agency, Tennessee Valley

Authority, Bureau of Reclamation, Fish and Wildlife Service, U.S. Geological Survey, and the Bonneville Power Administration. These efforts have involved watershed management activities, problems related to the spread of Zebra Mussels, problems related to the introduction of non-indigenous aquatic plants, environmental impacts of hydropower facilities, and impacts of water releases in tailwater areas on fisheries.

CUSTOMER SUPPORT

Increasingly, ERDC expertise and products developed in R&D programs are being requested to solve challenges in critical areas of concern. Following are a few examples of the many projects the ERDC conducts for its many customers.

I**ntegration of R&D with Dredging and Dredged Material Management.** Several reimbursable projects are supported through the application and implementation of DOER R&D products. Northwest Division, South Atlantic Division and Mississippi Valley Division are supporting demonstration of Innovative Technologies for assessing navigable depth estimation, capping technologies and long distant transport for beneficial uses of dredged material. The North Atlantic Division, South Pacific Division , Great Lakes and Rivers Division, and SERDP Program are supporting Risk based activities dealing with the management of contaminated sediments. The South Atlantic Division is supporting Environmental Resource Protection activities dealing with threatened and endangered species and environmental windows. Beneficial uses of dredged material as part of Dredged Material Management are being supported by the Great Lakes and Rivers Division. These activities fully integrate the R&D projects with field demonstration and research product implementation at the field level.

San Antonio River (TX) Habitat Restoration. The Ft. Worth District, and the San Antonio River Authority (SARA) were formulating and evaluating plans for habitat restoration of the San Antonio River. These plans included re-establishment of forested riparian zones, creation of meanders, and increasing complexity of substrate and flow patterns. Multiple restoration techniques were proposed for use individually and in concert. ERDC Scientists and Engineers were tasked with assisting the District in determining the combination of restoration measures that would provide the greatest cost-effective biological benefit to this project. Using innovative techniques and models developed under the Civil Works GI Program – Environmental Technologies - ERDC Scientists and Engineers performed field studies to: a) describe empirical relationships between physical habitats and fishes, b) develop habitat models appropriate for incremental analysis of habitat improvement alternatives, and c) quantify habitat for baseline (pre-project) conditions and for proposed restoration (post-project) alternatives. These studies were leveraged with existing Environmental Technologies R&D funding to address: “Habitat Value of Small Floodplain Pools for Fish and Amphibians”. The resulting ERDC report provided site-specific, multi-variable models for each class and combination of restoration techniques evaluated.

Truckee River (NV) Floodplain Analysis. The lower Truckee River flows south and east from Lake Tahoe, through the city of Reno, NV. The topography is mountainous resulting in a relatively steep and rocky channel and flashy events. From the last day of 1996 through the first few days of January 1997 the flood of record occurred resulting in flows in excess of 23,000 cfs and damage around half a billion dollars to the city and downtown Truckee meadows region.

In response to this event the Sacramento District of the U. S. Army Corps of engineers is performing a flood damage reduction study in which the Hydrologic Engineering Center (HEC) has been involved in the development of an unsteady HEC-RAS model for the Truckee river system. The HEC-GeoRAS software was used to develop the required terrain data for input into the HEC-RAS program, and will also be used to perform flood inundation mapping of model results. The HEC-FDA program is being used to compute damages for frequency based events, as well as performing the Risk and Uncertainty analysis. In addition to flood damage reduction analysis, this project also has a ecosystem restoration portion. The HEC-EFM model is being used on a piece of the lower Truckee river to analyze changes to the river floodplain habitat due to proposed changes in channel sizes and meandering patterns.

Walton County (FL) Coastal Storm Damage Reduction. The Mobile District is presently conducting a comprehensive analysis of coastal erosion processes along the 32-mile northern Gulf of Mexico shoreline encompassed by Walton County, FL, which includes the ever-popular bleached white recreational beaches of northwestern Florida. The

Beach-fx model development team including ERDC and Institute for Water Resources (IWR) personnel is providing engineering and economist support to the District by guiding the execution of computational models that characterize long-term and storm-induced sediment transport processes and coastal evolution, and well as developing required structure inventory data sets and needed damage functions. The Beach-fx model integrates the predicted long- and short-term coastal evolution processes with the economic valuation of existing structural inventory in an event-driven Monte Carlo simulation model that enables quantification of the economic consequences of multiple future scenarios of with- and without-project conditions. This technique provides a defensible risk-based economic evaluation of project costs and benefits together with uncertainty estimates.

Drakes Creek (TN) Ecosystem Restoration. Drakes Creek Restoration was undertaken as a Section 1135 Ecosystem Restoration to improve aquatic wildlife habitat in a floodwater conveyance. Drakes Creek is a major tributary embayment of the Old Hickory Reservoir on the Cumberland River, upstream from Old Hickory Dam. When Old Hickory Dam was closed in 1954, the upper end of the Drakes Creek embayment began to fill with silt. By the early 1990s, exposed mud flats had become apparent. As a result of this loss of aquatic habitat, the city of Hendersonville requested that the Corps (Nashville District) dredge the excess sediment that had accumulated and restore the Drakes Creek environment. At that point, the Nashville District requested technical assistance from ERDC. Using techniques developed under the Aquatic Plant Control Research Program (APCRP), ERDC researchers were able to provide: a) a plan for restoring a diverse aquatic plant community, b) all necessary plant propagules, c) a design for herbivore exclosures to protect the establishing plants, d) site preparation and planting, and e) monitoring assessments throughout the project.

Ports of Los Angeles and Long Beach (CA). An increase of harbor operations created the need for additional mooring areas within the two harbors. Modifications have resulted in extensive expansion and modification of the LA/LB harbors. The Field Data Collection and Analysis Branch operates and maintains a system of twelve wave gauges, located at strategic places in the harbor to assist the Los Angeles District in assessments of impacts of channel modifications, dredging operations, and breakwater performance; and, to help the Ports of Los Angeles and Long Beach determine the best location, orientation and configuration for required pier enhancements.

Harbor wave and water-level data provide the District and the Ports information for evaluation of hydrodynamic characteristics of the harbors and assists in decisions concerning pier construction, location, orientation and configuration. Measured data are used to calibrate and validate physical and numerical models. Near-real-time wave, water level and surge data are provided via the Internet for all locations. Statistical summaries are provided annually.

Chief Joseph Dam (WA). The Chief Joseph Dam (CJD) stretches over one mile across the Columbia River at river mile 545.1. Behind the dam lies Rufus Woods Lake, which extends 51 miles upstream to Grand Coulee Dam. The CJD is the Corps' largest power-producing dam. At the request of the Seattle District, a physical model (1:80) was designed and constructed at the ERDC by the Coastal and Hydraulics Laboratory. The model reproduces the spillway and powerhouse of the Chief Joseph Dam, and sufficient upper pool and tailrace length to reproduce prototype flow conditions near the structure. The model was used to evaluate the spillway flow deflectors and stilling basin performance.

Barrow Storm Reduction Study (AK). Storm events that cross the Chukchi Sea during the open-water season result in wave climates and storm surge that actively erode the coastline and threaten the communities of Barrow, Alaska. Design of shore protection at Barrow requires a thorough understanding of the wind, wave, surge, partial free ice coverage, and sediment transport climates. Both the short-term response (time scales of individual storm events) and long-term response (time scales on the order of the renourishment interval, years) must be accurately characterized.

The Coastal and Hydraulics Laboratory, in support of the Alaska District, performed an in-depth study that comprised five technical tasks: 1. Field Data Collection, 2. Wind and Wave Hindcast, 3. Nearshore Wave Transformation, 4. Wind-Driven Circulation and Storm Surge, 5. Sediment Transport and Beach Fill Design. Completion of the initial four tasks, ultimately led to the design of a beach fill project providing storm protection at Barrow, Alaska. The ultimate goal of this beach fill design is to protect the infrastructure in and around Barrow, Alaska. The tasks undertaken to accomplish this goal

included the deployment of ADCP gages in 5 and 10 meter water depths during ice-free conditions to collect frequency/direction wave spectra, current profiles, and water level data. Also, development of a 20-year deep-water and nearshore wave climatology using numerical models WAM and STWAVE, respectively. WAM used winds for the open-water months (approximately June through November) only. In addition, extreme event information was developed for wave, storm surge, and run-up using historical storm events occurring from 1954 through 2003. The numerical models WAM, STWAVE, ADCIRC and SBEACH, were used to research the extreme events. The sediment transport and beach fill design included sediment transport modeling performed with SBEACH and GENESIS and analysis to estimate initial beach fill volumes, beach fill longevity and maintenance requirements, and cross-shore beach profile evolution, both after placement and during storms. Finally, the efforts were supported by a field data collection during the open water seasons of 2003 and 2004, which provided nearshore wave, current and water level data.

Greenup Locks and Dam Model Study (KY). Greenup Locks and Dam is located at river mile 341.0 on the Ohio River. Built in 1962, the existing structure consists of two lock chambers, a 110 by 1200 main chamber and a 110 by 600 auxiliary chamber. Greenup Locks and Dam has a 30 lift and maintains a normal upper pool elevation of 515.0 feet. It has a 1042 dam consisting of 9 tainter gates with a clear span of 100 between 14 intermediate piers and two 15 end piers. It also has a 3 turbine power plant on the Ohio bank capable of producing a total output of 70,000 kilowatts. A 1:100 scale model was built that reproduces about 4 miles of the river channel. (Miles 339.0 343.0), approximately 2 miles of river channel upstream of the dam and 2 miles downstream of the dam and adjacent overbank area to about elevation 532.0 ft m.s.l. All structural appurtenances (the dam, locks, guard and guide walls and power plant) were fabricated of sheet metal and/or Plexiglas and set in their proper positions and elevations. The model was built from topographic and bathymetric surveys provided by the Huntington District.

The model has been used to document the existing navigation conditions for tows entering and exiting the main and auxiliary lock chambers. Evaluation and documentation of the study results with the existing navigation conditions are used to assure conditions observed in the model represent as close as possible the conditions that exist in the prototype based on information received from the District, navigation industry personnel and video recordings of tow traffic at the site. The model will be used to determine the optimal length of the upper and lower guard and guide walls to provide safe and efficient navigation conditions for barges entering and leaving the lock chambers.

INSTITUTE FOR WATER RESOURCES

BACKGROUND

The U.S. Army Institute for Water Resources (IWR) is a field operating activity under the staff supervision of the Director for Civil Works, Headquarters, U.S. Army Corps of Engineers (HQUSACE). The Institute is the USACE center of expertise for integrated water resources management (IWRM), focusing on planning analysis and hydrologic engineering; and the collection, management and dissemination of civil works and navigation information, including waterborne commerce data.

IWR was established in 1969 to provide the USACE with forward-looking analysis and state-of-the-art methodologies to facilitate the adaptation of the Civil Works Program to future needs.

Today, the Institute's mission is to support the Civil Works Directorate and the USACE MSC's and District offices by providing: (a) analysis of emerging water resources trends and issues; (b) state-of-the-art planning & hydrologic engineering methods, models and training; and, (c) national data management and results-oriented program and project information.

IWR CENTERS

IWR has offices at three locations, each of which is a designated USACE center of expertise (DX): the National Capital Region (NCR) office in the Casey Building at the Humphreys Engineer Center, Alexandria, Virginia; the Hydrologic Engineering Center (HEC) in Davis, California; and the Waterborne Commerce Statistics Center (WCSC), which is part of the NCR's Navigation Data Center (NDC), in New Orleans, Louisiana.

National Capital Region Office: IWR's NCR office provides the Corps DX for planning methods and analysis through a synergy of water resources planning and socio-economic expertise that blends practice with research, policy development and information. IWR planners, economists, social scientists, civil engineers and specialists in the physical sciences lead civil works strategic, planning and technology transfer initiatives; conduct national and focused policy development studies; develop a broad range of partnering and investment decision-support techniques, methods and models for IWRM and navigation system applications; provide national and international interface with the water resources community at-large; and, partner with the HQUSACE, Corps field offices and laboratories in solving complex technical water resources planning and evaluation problems.

Hydrologic Engineering Center (HEC): Since it's formation in 1965, HEC has pioneered the practice of river-based engineering, and its suite of hydrologic, hydraulic and planning models have set industry standards worldwide. HEC is the Corps DX for hydrologic engineering methods and models, with a critical mass of expertise in surface water hydrology, river hydraulics, hydrologic statistics, water control management, reservoir operation and flood risk analysis.

Navigation Data Center: NDC is the Corps DX for the management of information on infrastructure, utilization and performance of U.S. waterways and port and harbor channels. Because of the integrated nature of water resources, NDC also directly supports a range of related CW business areas, including: hydropower, recreation, environmental compliance, natural resources, regulatory, emergency and readiness; along with other Federal, state, local agencies; plus the private sector. The primary operational arm of NDC is **Waterborne Commerce Statistics Center** (WCSC), which provides one-stop capability for national navigation information systems. NDC also provides integrated business information in support of Corps decision making to include financial, output, and performance measurements.

FY 2004 SUMMARY

FY 04 was a challenging and busy year for the Institute for Water Resources (IWR), perhaps the most productive in its 35-year history. During FY04 IWR executed a Civil Works Program of $28 million with 156 in-house employees, primarily in professional disciplines with most possessing advanced degrees. IWR's in-house staff was supplemented by other experts detailed from USACE field offices and laboratories; Intergovernmental Personal Act (IPA) visiting scholars from universities and policy think tanks; and the private sector.

FY04 proved especially challenging as IWR underwent a significant internal re-organization to align

with USACE 2012, with the "new' IWR organizational structure based on a matrix team approach in-lieu-of a traditional function-based, stove-piped organization. IWR's new structure was approved in July 2004 upon approval of its updated Organization and Functions Statement, Engineering Regulation (ER) 10-1-23.

IWR's key accomplishments in FY04 include its central role in completing and releasing the USACE Civil Works Strategic Plan; publishing groundbreaking new research on maritime transportation economics that flowed from the Navigation Economic Technologies (NETS) Research Program; demonstrating the practical application of contemporary planning concepts through its support to the International Joint Commission on the Lake Ontario and St. Lawrence River Study; fielding new versions of HEC's flagship NexGen software products; improving and fielding new versions of the Corps Water Management System (CWMS) and the Civil Works Program's Operations and Maintenance Business Information Link (OMBIL); and executing a number of important technical assistance projects, including a growing number of significant activities in the international arena.

The accomplishments of IWR during FY04 are described in accord with its major functions.

ANALYSIS OF WATER RESOURCES TRENDS AND EMERGING ISSUES

Civil Works Strategic Plan: IWR staff led the development of the USACE Civil Works (CW) Strategic Plan (Fiscal Year 2004 – Fiscal Year 2009), which was completed and published in March 2004. The release of the CW Strategic Plan represented the culmination of a multi-year effort aimed at establishing a new direction for the Civil Works Program based on the contemporary "watershed" planning approach of Integrated Water Resources Management (IWRM). The plans five strategic goals are firmly grounded in the "systems" perspective of IWRM and are fully aligned with the principle of environmental sustainability. While the Strategic Plan recognizes that the USACE CW Program will continue to play a leadership role in its traditional water resources mission areas of commercial navigation, flood and coastal storm damage reduction, and ecosystem restoration, it also emphasizes that the Nation's 21st Century water resources challenges can only be solved through comprehensive, balanced and collaboratively-developed solutions that are approached in manner that embraces a holistic focus on water problems, with an emphasis on effectiveness to achieve more within existing resources.

The Institute provided technical support to HQUSACE and the MSC's in the development and execution of the communications plan for the Strategic Plan's release, and also assisted in the FY04 phases of the plans implementation throughout the USACE organization.

USACE Chief Economist: During FY04 Dr. David Moser of IWR was designated by HQUSACE as the USACE Chief Economist and leader of the Economics Sub-Community of Practice (CoP). FY04 activities included the organization of senior MSC economics group, and the organization of a national meeting of senior economists. The updated survey of the composition and level of expertise comprising the USACE Economics CoP was commissioned, and work proceeded on the update of water resources planning National Economic Development (NED) Manuals (a NED Overview Manual and updated guidelines or flood damage reduction and deep-draft navigation). Activities also included the design of a career path template for Corps economists, and the scoping of future work on defining competence standards and training programs. The USACE Chief economist also participated in selection boards for senior economists throughout the Corps, and in the conduct of Independent Technical Reviews (ITRs) on the economics component of a complex navigation project studies across the USACE.

National Shoreline Management Study: The National Shoreline Management Study (NSMS) is a collaborative, interagency effort to determine the extent and cause of shoreline erosion along the coasts of the U.S. The NSMS is also assessing the national level economic and environmental impacts of such erosion, and is examining the appropriate Federal and non-Federal roles and policies in shore protection activities. From a technical and policy standpoint, the NSMS is also assessing the use of subsystems approaches to management sediment holistically (Regional Sediment Management or RSM) in close coordination with related USACE and other intergovernmental activities, including the RSM demonstration projects being conducted by Corps districts and the ongoing coastal research of the Coastal-Hydraulics Laboratory (CHL).

Policy Development: The Institute conducted a range of policy development studies in 2004, including continuing interagency coordination and research on the Economic Value of Environmental Services; The Use of Scenario Analysis in Level C Planning Studies; 2004 Water Supply Survey and Database; A Framework for Risk Analysis in Ecological Restoration Projects; Potential Uses of Incentive Systems for Implementing the Civil Works program; and dozens of Policy–oriented Issue and White Papers. The Institute also conducted a series of Civil Works "provocations" with the HQUSACE leadership on selected water resources issues and future challenges, with discussion of the implications to the future CW Program. Key issues addressed at the provocations included globalization and the world economy; aging infrastructure and constrained budgets; and emerging regional competition for water within the U.S.

NATIONAL INTERFACE AND PARTNERING

Environmental Advisory Board: Beginning in FY04, the Institute assumed a lead technical role in supporting the interface with the Chief's Environmental Advisory Board (EAB, a Federal Advisory Group). In this role the Institute leads a team of specialists drawn from throughout the Corps in partnership with ERDC. Technical support in 2004 focused on six themes which the EAB was engaged in: (1) Implementing the Corps Environmental Operating Principles; (2) Objectives for National Ecosystem Restoration Program; (3) The Role of Adaptive Management in Water Resources Decision-Making; (4) New Institutional Relationships and Procedures; (5) Environmental Performance and Investment Accountability; and, (6) Re-defining Stakeholder Interest.

Inland Waterways Users Board: The Institute continued its support of the Inland Waterways Users Board (IWUB) in FY04, including the analysis of and reporting on the financial status and capability of the Inland Waterway Trust Fund (IWTF) at meetings of the Board, and the administration of IWUB Meeting No. 46 on February 19th, 2004 in Washington, DC. The Institute also provided technical support to the IWUB in its development of the Board's 18th Annual report to the Secretary of the Army and the U.S. Congress, published in March 2004.

National Outreach: IWR's FY04 technical interface activities included collaborations with a wide range of national research, professional, industry and non-governmental organizations, including: National Research Council's Water Science and Technology Board, the Transportation Research Board, and the Marine Board; the American Society of Civil Engineers (ASCE) Environmental and Water Resources Institute (EWRI) and Coasts, Oceans, Ports and Rivers Institute (COPRI); the American Water Resources Association (AWRA); and the American Association of Port Authorities (AAPA), to name just a few.

The Nature Conservancy Sustainable Rivers Project: USACE and The Nature Conservancy (TNC) signed an MOU committing each to an activity called the "Sustainable Rivers Project". This project seeks to leverage the knowledge and skills of TNC and USACE in altering the operation of USACE reservoirs so as to improve the ecosystem sustainability of downstream river reaches. To further this initiative through technical support, HEC committed to an IPA (Intergovernmental Personnel Act) agreement wherein an HEC engineer would work full-time with TNC for an initial one-year period to facilitate the project. In FY 2004, HEC's appointed IPA engineer served as a liaison and resource for both USACE field offices and TNC for projects on the Savannah River, Ashuelot in New England, and Willamette River in Oregon. In FY 2005, potential projects are likely for the Bill Williams River in Arizona, and two other as yet selected rivers.

IWR Visiting Scholar Programs: FY04 marked the third year for the Institute's Maass-White Visiting Scholar program, established in 2001 in recognition of the contributions of, and the Institute's intellectual alignment with, two of the founders of modern water resources analytical theory – Professors Arthur Maass, Harvard University and Gilbert White, the University of Chicago. FY 2004 also was the first year for two other designated visiting scholar positions: one in partnership with the Universities Council on Water Resources (UCOWR), and HEC's Roy Beard Visiting Scholar program – named after the founding director of HEC. Each of these programs seek to bring the foremost water resources experts from academia, private industry, and other agencies and laboratories to residence at IWR or HEC for periods of six months to one year. Visiting scholars are expected to help infuse new energy and ideas to the IWR program, while the

practical work environment at IWR/HEC provides a stimulating context for mutual exploration of potential advances in hydrologic engineering and planning analysis.

IWR's Maass-White Scholars have included Dr. Daniel (Pete) Loucks, Cornell University (2001-2002), Dr. Peter Rogers, Harvard University (2002-2003) and Dr. Leonard Shabman, Resources for the Future, (2003-2005), while the inaugural UCOWR Fellow is Dr. Bruce Hooper, Southern Illinois University (2004-2005), who is working on performance indicators for successful watershed-based organizations. HEC's first Roy Beard visiting scholar was Mr. Tony Thomas, founder and president of Mobile Boundary Hydraulics. Mr. Thomas provided fresh insight and ideas related to sediment modeling and mentored HEC staff in developing sediment analysis features for HEC-RAS.

WATER RESOURCES METHODS AND MODELS

Planning Models Improvement Program: In FY04 the HQUSACE Director of Civil Works approved the recommendations of the Planning Model Improvement Program (PMIP) Task Force, which was co-directed by IWR. Key HQUSACE commitments included publishing guidance in 2005 that prescribes a corporate business process and policy for the development, certification, training and on-going support for planning models, with the certification process based on internal and external peer support and review, and with the responsibility for establishing priorities and managing the certification process residing with the planning centers of Expertise, in coordination with the findings of Strategic Engineering and Technology (SET) Initiative. This policy ultimately manifested in 2005 as Engineering Circular (EC) 1105-2-407. Also key to PMIP recommendations was the coincidence with the peer review protocols being used as part of the NETS research program for navigation analysis models.

Navigation Economic Technologies Research: For more than a century the U.S. Army Corps of Engineers has played a key role in maintaining a robust national economy by ensuring that farmers, manufacturers and businesses can easily transport goods up and down our nation's rivers and out to sea via coastal ports. The Navigation Economic Technologies (NETS) Research Program supports the navigation mission by developing state-of-the-art, credible, independently verified economic models, tools and techniques to be used to USACE field planners in informing investment decision-making at all levels of the agency.

To ensure that our nation's navigation system remains as efficient, effective and affordable as possible, the NETS research is aimed at developing a standardized and transparent knowledge base and associated suite of economic evaluation tools for addressing these issues. Key focus areas include: analyzing shipper behavior and responses, particularly decisions to switch to non-water modes of transportation, and assessing global market conditions, including the impact of international competition and commodity flows.

The NETS research program has two primary focal points: expansion of the body of knowledge regarding the economics underlying use of waterways and harbors, and creation of a economic decision-support toolbox of practical planning models, methods and techniques that can be applied to a variety of situations. The knowledge and tools developed by the NETS research program is based on: reviews of economic transportation and market theory; current best practices both within and outside of the Corps; data needs and availability; and peer recommendations.

In FY04, NETS produced significant research findings, including work focusing on how changes in water transportation shipping rates affect grain elevator shipper's demand along the Upper Mississippi River. Results from a survey of mid-American gain shippers included an indication of the strength and relationship of both transportation rate and transit time. Findings evidenced a significant percentage of shipper's surveyed who would not change shipping mode or origin/destination even if waterway rates were significantly increased (i.e., even if rates doubled). The survey also found that increases in transit time affect shipper demand irrespective of rate increases. Both findings are significant and constitute a major step towards informing the design and use of new modeling approach for evaluating waterway investments.

NETS work units in FY04 also produced a survey of agriculture and non-agriculture shippers on the Columbia-Snake Rives system that will serve as the basis for designing further improvements to waterway econometric analysis and models; a beta version of the

IWR-HarborSym Model that now offers an improved Graphical User Interface for data entry and customization of the harbor network for modeling costal harbor vessel movement behavior, Monte Carlo simulation for quantifying risk and uncertainly, detailed model outputs including vessel delay times and transportation costs and simulation and 3-dimensional post process animation capability.

At the close of FY04, NETS researchers were preparing to present key results at the January 2005 meeting of the National Research Council's Transportation research Board (TRB), including the presentation of seven technical papers.

Looking ahead to 2005, NETS research is in the process of developing a series of practical tools and techniques to be used by Corps navigation planners across the country to develop consistent, accurate, and comparable information regarding the impact of proposed changes to navigation infrastructure or systems. The centerpiece of these efforts will be a suite of simulation models that include:

- A model for forecasting international and domestic traffic flows and how they may be affected by potential projects.
- A regional traffic routing model that will identify annual quantities of commodities from various origins and routes used to satisfy forecasted demand at each destination.
- A microscopic event model to generate routes for individual shipments from origin to destination in order to evaluate alternative measures.

Cost Effectiveness and Incremental Cost Analysis: The Institute deployed an updated version of IWR-PLAN (Version 3.33), which is a water resources investment decision-support tool that performs cost-effectiveness and incremental cost (CE/IC) analysis associated with the formulation and evaluation of planning alternatives which produce non-monetary or a combination of monetary and non-monetary outputs. Developed in partnership with the Social Sciences Institute and the Department of Interior's Natural Resources Conservation Service (NRCS), IWR-PLAN was originally designed to assist with the development and comparison of alternatives plans for ecosystem restoration and watershed planning studies. However, the program can now be applied to a wide variety of integrated water resources planning and management (IWRM) problems by helping identify which plans are the best financial investments by displaying and comparing the effects of each plan on a range of decision variables.

Transportation Systems: IWR's Transportation Systems program supports Corps districts and HQUSACE in accomplishing navigation project planning and valuation responsibilities through the provision of uniform, consistent maritime transportation data on the operation and replacement of commercial waterborne vessels and comprehensive statistics on the composition of the world deep draft fleet and world trade and cargo flow forecasts. FY04 accomplishments include the update and publishing of 2004 shallow draft vessel operating costs and updated vessel fuel costs ; updated vessel characteristics for ocean-going barge costs; completion of a deep-draft vessel operating applications manual; updated barge, rail and truck alternative transportation modal models, and completion of a desktop-tidal delay model.

Flood Damage Data: The Institute's Flood Damage Data program provides a centralized, consistent and cost-effective inventory of depth damage results for use by all USACE district planners, while providing a mechanism for conducting and consolidating actual flood damage surveys following flood events for both coastal and riverine events. Accomplishments in FY04 included the design, testing and release of updated OMB approved questionnaires for the field conduct of flood damage surveys, the development of generic residential and business depth damage relationships, with a residential depth-damage function application released for Corps-wide use.

System-Wide Water Resources Research: FY 2004 was marked by a major joint effort of IWR, led by HEC, with the Engineer Research and Development Center (ERDC) laboratories in shaping the new System Wide research and development program, a program focused on expanding the view of research activities to the 'System Wide' perspective, reflecting a concerted

effort by USACE to better work consistent with concepts of sustainable development in a watershed context. The effort has thus far been most successful, portending the development of new and exciting products for field office use in the coming years. It should be noted that most of the IWR software and new methods development is funded from this and other USACE civil works research programs.

NexGen Software: An update to HEC-HMS was released, fixing a number of deficiencies as well as modestly improving several features. This version of the Corps standard watershed model includes a moisture accounting loss algorithm and several improved display and interface features. Substantial progress was made on the next major release version that will replace the user interface with newly designed functionality, and completes the transition from the proprietary user interface platform of the past. At fiscal year end, a candidate release version was undergoing initial field-testing. Besides replacing the proprietary user interface, new technical features include automated frequency curve development, the addition of snowmelt capability, and incorporation of interior flooding simulation capability. The companion GIS utility package (HEC-GeoHMS) is being updated and new features added to prepare for a parallel release with the new HMS version. This utility provides substantial capability to effectively use national terrain data sets to rapidly develop HEC-HMS models.

At fiscal year end, final touches were being put on HEC-RAS (Version 3.1.3) for release in FY 2005. This version completes the unsteady flow capability, adds several new features including the first release with sediment transport capabilities. The companion GIS utility package (HEC-GeoRAS) has also undergone improvements and will be released simultaneously with HEC-RAS Version 3.1.3.

The major flood damage and risk analysis software package, HEC-FDA, continues to be improved, with progress made in integrating the event program HEC-FIA, nonstructural measures and GIS capabilities into the risk analysis program HEC-FDA. The projected release schedule for the new version is late in fiscal year 2005.

Following the well-received release of the new stand alone NexGen software package HEC-ResSim (Version 2.), major work to add new features has been intensively pursued. Major new capabilities in hydropower simulation, forecasted flow operations, and multi-reservoir simulations were completed and at fiscal year end, were undergoing field-testing. Projected release schedule for the new version is late in fiscal year 2005. HEC-ResSim features a map-based schematic development environment, simulation of multiple dams and outlets, and an operations scheme to define the reservoir's operating goals and constraints in terms of pool zones and zone dependent rules. Important capabilities include operation of multiple reservoirs for a common downstream control (while balancing storage among reservoirs), configurable plots, integration with HEC-DSSVue, and a familiar Window look and feel.

Under development for several years, a new program coined HEC-EFM (ecosystem functions model) is emerging as a valuable link between traditional flow-based watershed analysis and ecosystem response. A release is planned in FY 2005.

Another new initiative begun in FY 2004 and carrying through FY 2005 has been coined HEC-WAT, watershed analysis tool. This software will be the integration environment for HEC models, and later program packages developed by others. The HEC models of RAS, HMS, ResSim, FDA, and EFM are to be seamlessly linked in the WAT system.

INTEGRATED CIVIL WORKS SYSTEMS

OMBIL: NDC's production databases provide water resources facility inventories, outputs, and activities that are integrated into a centralized performance management information system – the Operations and Maintenance Business Information Link (OMBIL). OMBIL encompasses the Civil Works businesses of navigation, hydropower, recreation, environmental compliance, natural resources and regulatory. These data are combined and internally distributed through OMBIL decision support system to support a variety of Corps management initiatives, as well as federal and public data requirements.

In support of the Civil Works business performance measurements, NDC extracts expenditure data from CEFMS and combines it with the different business output data to generate efficiency and

effectiveness measurements. These measurements are for both internal use in the Corps https://ombil.usace.army.mil and submission to higher authority including the Office of Management and Budget (OMB). Also, NDC data supports and is a source for the Corps "Value to the Nation" and the federal government's recreation access site "rec.gov".

The navigation data has been integrated with CorpsMap that provides an intranet web-based GIS interface. This web site includes many of the Corps other data layers such as Digital Project Notebook, Inventory of Dams, Bridge Inventory Database, Division and District Boundaries and Real Estate Holdings plus many standard layers such as state, county, congressional district, zip codes and etc.

All of NDC's publicly available navigation and water transportation data is available via a single gateway at www.iwr.usace.army.mil/ndc or on its annual CD-ROM. The site also provides links to other Corps, Federal and public sites related to the navigation business. NDC continues to strive to provide single site portals related to various management views for accessing all data and information

CWMS: The project to modernize the Water Control Data System (WCDS) software began in FY 1997, was fielded in its first operational state in 2002/2003, has undergone substantial improvements. Two subsequent nation-wide updates have occurred to the thirty plus USACE offices with water control management responsibilities. The CWMS is the decision support Automated Information Systems (AIS) that supports the Corps water management mission. It embodies data acquisition, validation, transformation and management; forecasting, simulation and decision support analysis; and information dissemination. Improvements to the system continue via a field-prioritized betterments program. The improved CWMS will be released for upgrading existing field installations in calendar year 2005. Improvements include the addition of snow-melt modeling, several new features in HEC-ResSim, the capability of storing, retrieving, and editing rating table information, upgraded data stream processing, new security features, and visualization scaling. The management and funding structure provides for a modest field-directed betterments program that will be ongoing throughout the life cycle of CWMS. Information about CWMS and other HEC software is available on the HEC Web site: http://www.hec.usace.army.mil/cwms/.

WATER RESOURCES TRAINING AND EDUCATION

PROSPECT Program and Specialty Workshops: IWR continued the USACE PROSPECT training program rebound by presenting twenty-three week-long courses (twelve led by the IWR NCR and eleven by HEC) and five field workshops that totaled an additional five weeks of training. The courses covered a wide range of civil works water resources topics: Public Involvement and Teaming in Planning; Public Involvement – Communications; Regulatory for New Regulators; Regulatory - Procedural Issues; Regulatory - Decision-Making; Regulatory Executive Seminar; Eco-system Restoration Planning/Evaluation; Economic Analysis; and a full menu of hydrologic engineering and planning analysis topics including courses on HEC-RAS, HEC-HMS, GIS applications, watershed/river and wetlands restoration courses, and advanced courses in unsteady flow and HMS applications. Attendance averaged about 25 students per course.

The specialty workshops focused on HEC software such as HEC-ResSim, HEC-RAS, HEC-HMS and HEC-DSSVue; the use of navigation data and information systems; IWR-PLAN and cost effectiveness and incremental cost analysis (CE/IC); and IWR-MAIN and water supply forecasting.

Planning Excellence Program: Throughout FY 04 IWR provided technical support to the Civil Works Planning Community-of-Practice in the execution of key elements of the Planning Excellence Program. This included the conduct of the two-week "Washington-Experience" orientation for the FY04 class of USACE Water Resources Planning Associates; management of the UCOWR partnership and further development of distance learning components of the Water Resources Planning and Management Master's Degree Program now offered at four Universities: Johns Hopkins, Southern Illinois University, the University of Florida, and the University of Arizona; and with plans advancing for the inclusion of programs at Tulane and Harvard University. IWR also provided support to the local delivery of selected Planning Core Curriculum Courses by the Corps MSC's. These eight courses

provide the basic, full performance training needed by entry level planners across the USACE as the means to accelerate their progress to the journeyman stage of their career development.

REIMBURSEABLE TECHNICAL ASSISTANCE

Reimbursable project work was undertaken for Corps field offices as well as HQUSACE Civil Works Planning and Engineering, the Corps Engineering Research and Development Center Coastal and Hydraulics and Environmental Labs, the Federal Emergency Management Agency, the U.S. Department of Transportation - Federal highway Administration, the National Institute for Building Sciences, and other Federal agencies. Projects for IWR clients included navigation systems economic evaluation, technical advice and guidance on plan formulation, incremental cost and cost effectiveness (IC/CE) analysis, risk analysis, watershed and reservoir system modeling, water quality, river hydraulics, wetlands hydrology, water control management, regional statistical analysis, flood damage analysis, flood warning response systems, GIS applications in hydrology and hydraulics, groundwater modeling and water supply in support of the CALFED investigations.

Among the most notable projects included participation on the National Technical Review Committee for the Louisiana Coastal Area (LCA) Study and publication of the report "Lesson Learned by the National Technical Review Committee for the LCA Study"; and HEC's conversion of existing UNET unsteady flow models for Jefferson Parish, LA to a HEC-RAS platform for compatibility with current floodplain management studies. Independent Technical Reviews (ITRs) were performed for a variety of plans formulation, economic and hydrologic studies, including a National Data Quality Act challenge to a southern California stream frequency curve, and spillway design studies for reservoirs in the central valley of California. For the Savannah River Drought Contingency Study – HEC developed new hydropower simulation capabilities in HEC-ResSim to support system hydropower operations, pump-back storage operation, period average operation goals, and numerous other capabilities needed for the drought study and an on-going comprehensive study of the Savannah watershed

CIVIL WORKS PROGRAM AND PROJECT INFORMATION

IWR provides a full range of information on key Civil Works activities including international, national and Corps-wide data and information. National water resources database concept development, design, implementation, operation, and maintenance activities are provided through a combination of in-house and private sector systems analysts, statisticians and engineers/scientists who work in close coordination with Corps users.

The Navigation Data Center (NDC) is the central manager of navigation data for the Nation, and NDC provided information directly supports the Corps $1.8 billion annual navigation program in addition to all other CW programs. NDC is responsible for national level executive oversight and management responsibilities such as the development of both federal and Corps policy and guidance involving Engineering Regulations and the Code of Federal Regulations and their enforcement. The Office of Management and Budget, acting on legislative mandates, recognizes USACE, acting through NDC, as the Federal collection agent for waterborne commerce, vessel activities and waterway infrastructure data and statistics.

NDC accomplishes its objectives of supplying timely and accurate data through the following activities: 1) Assessing user requirements; 2) developing, designing, and operating and maintaining systems to collect, process, and store data and information; 3) developing and disseminating data, information and statistics products; 4) training of providers and users; 5) maintaining technological and content interoperability and currency.

As a national statistical center, NDC coordinates extensively with other federal statistical agencies and federal data users, and represents the U.S. Government with foreign governments in the development of data and information standards and protocols; and in the negotiation of data exchanges. Within the Corps NDC actively participates in corporate information integration and coordination and plays a lead role in developing, coordinating and disseminating water resources information for performance measurement and management purposes, and in assisting in the development of strategic communication with both

internal communities of practice and external water resources interests, stakeholders and communities. Key information and data provided in FY04 include:

Waterborne Commerce and Vessel Statistics: Under the authority of the River & Harbors Act of 1922, as amended, and codified in 33 U.S.C. 555 the Corps is to collect, process, distribute, and archive commercial vessel trip and cargo data. These data and statistics are used to analyze the feasibility of new water transportation projects and activities; to set priorities for new investment and rehabilitation; and for management of the operations and maintenance of existing projects.

Under Federal law, vessel-operating companies must report domestic waterborne commercial vessel movements directly to the Corps. The types of vessels include: dry cargo ships and tankers, barges (loaded and empty), towboats (with or without barges in tow), tugboats, crew boats and supply boats to offshore locations, and newly constructed vessels from the shipyards to the point of delivery. Vessels remaining idle during the monthly reporting period are also reported.

U. S. Foreign waterborne import, export, and in-transit cargo and vessel movement data are provided to the Corps by the U. S. Customs Service, the Bureau of the Census, and the Port Import Export Reporting Service.

Movement data acquired by the Waterborne Commerce Statistic Center of NDC is primarily for the use of the Corps and other governmental agencies. In 2004 these data were incorporated into the Corps budget preparation process and provide the navigation project outputs and performance measures used to rank and justify operation and maintenance funding requests. Summary statistics, which do not disclose movements of individual companies are also released to private companies and to the general public.

The Waterborne Commerce Statistics Center's standard publication, *Waterborne Commerce of the United States*, is issued in five parts (Atlantic Coast, Mississippi Valley and Gulf Coast, Great Lakes, Pacific Coast, and a National Summary). Also available is *The Public Domain Database* that contains aggregated origin to destination information of foreign and domestic waterborne cargo movements.

Transportation Lines of the United States in three volumes contains a national summary of U.S. vessels, listings of domestic vessel operators, plus details their equipment and references their service areas.

Ports and Waterways Infrastructure: This information supports the Corps Federal Central Collection Agency responsibility for documenting the nation's commercial port infrastructure served by Federal channels. In FY 2004, one of the 56 volume Ports Series (PS) Reports was completed, distributed, and available for sale, PS.No.69 – Ports of Minneapolis - St. Paul, MN and Ports on Upper Mississippi River (Miles 300-860 AOR). In addition to the completed reports, field surveys were conducted and data entered into the Ports and Waterways Information Management System (PWIMS) for the following: PS No. 11 – The Ports of Hampton Roads and Ports on the James and York Rivers, VA; PS No. 39 – The Ports of Southwest and Western Alaska; PS No. 65 – Ports on the Illinois Waterway (Miles 0-291, Grafton to Lockport); PS 70 The Port of St. Louis, MO and Ports on the Upper Mississippi River (Miles 300-860AOR); and PS No. 72 – Ports of Natchez, Vicksburg, and Greenville, MS; and Ports on the Lower Mississippi River (Miles 255-620 AHP). Data for the 9,280 individual docks are available in summary form and as data files on the Internet. These data are updated and posted as each port area is re-surveyed and verified as current. The data are of interest and used by the Coast Guard in their homeland security and safety missions.

Lock Performance and Characteristics: The lock performance database provides the Corps access to individual lock near real-time information. The U.S. Coast Guard also uses the data in their homeland security mission. A national data warehouse that will provide all Corps users direct access to current and historical data and summaries has been designed, constructed and is in final testing before full deployment. Lock characteristics, the physical descriptions of all the Corps owned and operated locks, are available on the web. The lock databases also feed to the OMBIL decision support system

Dredging Statistics: This web-based ORACLE database is successful in supplying information on all

USACE performed and contracted dredging to the Corps, industry and private users. Data entry and report generation is accomplished via the Corps Intranet and enables all Corps members access to the information in the central system. The data are used to generate the Small Business Report for dredging contracts. Biweekly reports are posted on the public web site to inform the industry and public of Corps and contracted dredging activities. Standard reports and summaries plus custom queries and reports are quickly generated to meet Corps and user needs. The use of the information by Corps and industry has resulted in improved bidding competition and a more efficient utilization of dredging equipment. The dredging database is a feeder system to the Operations and Maintenance Business Information Link (OMBIL) decision support system.

All of NDC's publicly available navigation and water transportation data is available via a single gateway at www.iwr.usace.army.mil/ndc or on its annual CD-ROM. The site also provides links to other Corps, Federal and public sites related to the navigation business. NDC continues to strive to provide single site portals related to various management views for accessing all data and information. Most data are available in both hard copy and electronic form.

Water Supply Survey and Database: IWR partnered with Corps MSC's and district offices in FY04 to produce an updated water supply database that cataloged all USACE projects with municipal and industrial (M&I) water supply (134 projects), along with information on the number of M&I water supply agreements (295), reallocations, water supply studies underway, revenues received and the costs of collection, local sponsors, water supply project yields, and an interactive e-map of the water supply project locations. The results of the survey were published in IWR Report 05-PS-1, with the database information used to inform the Value to the Nation Water Supply web site.

Value to the Nation Information: The Institute also provides a repository of summary information the economic, environmental and societal benefits provides through the various missions associate with the Civil Works Program. This information is provided both on the web where it is accessible for electronic download, and in hard copy format. Through FY04, a series of 15 summary fact sheets - brochures on the full range of Civil Works mission areas and integrated water systems have been completed and employed on the web.

INTERNATIONAL WATER RESOURCES

Lake Ontario and St. Lawrence River Study: The International Lake Ontario-St. Lawrence River Study is being conducted by the International Joint Commission (IJC) to assess and evaluate the Commission's *Order of Approval* used to regulate outflows from Lake Ontario through the St. Lawrence River. This five-year, $20 million study is evaluating the impacts of changing water levels on shoreline communities, domestic and industrial water users, commercial navigation, hydropower production, the environment and recreational boating and tourism, along with forecasted effects of climate change. The study is being conducted in full partnership with Canada, and is utilizing a transparent planning process pioneered by IWR and known as "Shared Vision Planning". The open citizen and public participation process is being guided by a volunteer Public Interest Advisory Group (PAIG) appointed by the IJC, while the study team is composed of a broad assembly of multi-disciplinary technical experts on nine technical working groups and led by co-director's from Canada and the U.S. The U.S. co-director is Dr. Eugene Stakhiv of IWR.

During FY04 a series of alternative plans were developed and their impacts assessed and presented to basin interests through a series of fifteen public meetings held simultaneously in the U.S. and Canada. Feedback was received on the full range of alternative plans which are expected to be narrowed to a smaller subset of candidate plans which will be further coordinated with the public as the Study Board continues towards the completion of its report to the Commissioners in 2005.

World Water Council: The CECW Deputy Director for Civil Works represents the USACE on the World Water Council (WWC), with IWR providing technical support and representation on the Council's Institutions and Governance Committee. FY04 activities included the continued planning for the 4th World Water Forum (WWF) which will be held in Mexico City in March 2006, and the development and coordination of USG input into the construct of the 4th

WWF agenda, consistent with Department of State guidance on international water initiatives consistent with USG policy, such as the Millennium Declaration Goals and planning for the United Nations sustainable development conference in 2005 (CSD-13).

USACE – UNESCO IHE Partnership: IWR is the USACE technical agent for administering the Memorandum of Understanding (MOU) between the USACE and UNESCO - Institute of Water Education (IHE). The most significant activity in FY04 was the initiation of 18 month in-residence Master's Degree training for 16 water specialists from the Iraqi Ministries of Water Resources and Public Works at the IHE-Delft, Netherlands.

UNESCO – IHP: The IWR director was part of the United States Government (USG) delegation attending the 16th Session of the UNESCO International Hydrologic Programme (IHP) Intergovernmental Council in Paris, France, 20-25 September 2005. This delegation represented the USG as a precursor to the establishment of the U.S. IHP National Committee, which is being planned for 2005 in conjunction with the formation of the U.S. National Commission upon the USG reentry into UNESCO.

USACE - Dutch Rijkswaterstaat Memorandum of Agreement: The Dutch Rijkswaterstaat (RWS) and the USACE) signed a Memorandum of Agreement (MOA) in May 2004. The scope of that agreement encompasses collaboration in research, development, testing, and evaluation potentially leading to new and/or improved capabilities between the two countries. IWR has the technical lead in the implementation of MOA activities. Upon the signing of the MOA, a strategy was developed to focus the technical exchange along practical lines that were mutually beneficial to the missions of both organizations. Accordingly, six specialty (cluster) areas were formed with co-leaders from both countries identified to lead each specialty area:

- Flood control and flood protection
- Coastal zone management
- River basin management
- Shipping and transport
- Dredging
- Infrastructure management

Several cluster group technical exchanges took place in 2004 in both the US and The Netherlands, along with a follow-up visit to the U.S. where the USACE hosted a visit by the RWS Director-General, with joint events in both Washington, D.C. and New Orleans, Louisiana.

International Technical/Reimbursable Projects: FY 2004 yielded major growth in technical assistance projects undertaken in cooperation with non-Corps, non-Federal organizations. This includes work in Iraq and Afghanistan for USAID and its contractors, and local government agencies. Projects for these varieties of clients and settings include watershed and reservoir system modeling, water quality, river hydraulics, wetlands hydrology, water control management, regional statistical analysis, GIS applications in hydrology and hydraulics and groundwater modeling.

Notable international projects include historic data reconstruction and water management system modeling of the Tigris and Euphrates in Iraq, the Helmand Valley in Afghanistan, and an Independent Technical Review (ITR) for flood studies of military installations in Korea, and for flood risk indicators for the UNESCO-Center for Flood Risk and Hazard Mitigation in Tsukuba, Japan.

INTERNATIONAL NAVIGATION ASSOCIATION (PIANC)

PIANC is an organization consisting of approximately 40 national members. From its headquarters in Brussels, Belgium, it acts as a clearinghouse of technology and experiences relating to ocean and inland navigation improvements which are exchanged among engineers, scientists, port operators, and marina and vessel owners, to name a few. Its objective is to advance, on a worldwide basis, the sustainable development of all kinds of navigation through the exchange of technical information on port and waterway development. The objective of the Association is met by holding International Congresses and by publishing technical bulletins and special reports. Special reports are published describing the results of the work of international research teams, or working groups, composed of those national members interested in the particular subject under study. The organization also serves as an excellent source of identifying individual and corporate expertise

throughout the world on PIANC-related subjects. Personal interchange of ideas and information also is promulgated by members attending the International Congresses held once every four years, and technical working group meetings held several times each year.

The business affairs of the Association are managed by the Annual General Assembly (AGA). It is composed of delegates who represent each member government. The number of delegates is determined by the size of the national membership, but may not exceed 11 per country.

The United States (U.S.), which has been a member of PIANC since 1902, provides an annual appropriation for the support and maintenance of the organization. This includes an annual subvention to PIANC International and payment of a portion of the travel expenses of officially appointed national delegates (Commissioners) of the United States to meetings of the AGA and Congresses. Total annual appropriation for the U.S. Section, PIANC is currently $45,000, including the annual subvention of approximately $15,000.

The U.S. Section is administered by law, under the auspices of the Department of the Army (Corps of Engineers). It is located in the Institute for Water Resources (IWR), Casey Building, Humphreys Engineer Center. The U.S. Section is composed of both individual and corporate members who pay membership dues. Membership of the U.S. Section on September 30, 2004, totaled 263, consisting of 216 individual members, 46 corporate members and 1 student member.

United States National Commission: The United States National Commission constitutes the governing body of the National Section. In 2004 the ex-officio officers of the U.S. National Commission were: Chairman, John P. Woodley, Jr., Assistant Secretary of the Army (CW)); President, MG Don T. Riley, Director of Civil Works; and Secretary, Mr. Ronald R. Conner an employee of IWR.

In 2004, U. S. National Commissioners were: Mr. Robert D. Nichol, President, Moffatt and Nichol Engineers; Mr. Kurt J. Nagle, President, American Association of Port Authorities; Mr. Charles C. Calhoun, Jr., Vice President representing the Central Region and consultant; Dr. Robert H. Randall, Texas A&M University; Mr. Joseph H. Pyne, President, Kirby Corporation; Ms. Doris J. Bautch, Director, Great Lakes Region, Maritime Administration, U.S. Department of Transportation; Mr. Shiv Batra, Vice President representing the Western Region and President, INCA Engineers, Inc.; and Mr. Thomas H. Wakeman, III, Vice President representing the Eastern Region and General Manager, Waterways Development Division, Port Commerce Department, Port Authority of New York and New Jersey.

In July of 2004, MG Don T. Riley replaced MG Carl A. Strock as Director of Civil Works for the U.S. Army Corps of Engineers and also assumed the position of President of the U.S. Section. Mr. John P. Woodley, Jr., Assistant Secretary of the Army (Civil Works) continued to serve as Chairman, U.S. Section PIANC.

In 2004, the U.S. Section PIANC appointed a new Treasurer, Joe Mantey, Principal Economist and Associate with the Greeley-Polhemus Group, Inc. Mr. Mantey brings more than 25 years of experience in both government and the private sector. His banking experience includes one year as Chairman and four years as a Member of the Board of Directors of the U.S. Engineers, L.A. Federal Credit Union.

PIANC Activities: In February of 2004, Mr. John P. Woodley, Jr. made a presentation to the American Association of Port Authorities Latin American Executives Meeting in Miami, Florida. This activity was part of the Inter-American Initiative being led by the U.S. Section PIANC.

In May of 2004, a U.S. Delegation composed of MG Don T. Riley, Mr. Ronald Conner, Mr. Shiv Batra, Ms. Doris Bautch, Mr. Harry Cook, Mr. Robert Nichol, and Mr. Thorndike Saville attended the Annual General Assembly in Fukuoka, Japan. Dr. Robert Engler and Dr. Sandra Knight also attended. The major resolution arising from the Fukuoka meeting was entitled “Navigation for Sustainable Growth.”

In partnership with the Coasts, Oceans, Ports and Rivers Institute of the American Society of Civil Engineers, the U.S. Section cosponsored PORTS 2004 in Houston, Texas May 23 to 26, 2004. The theme of the conference was Port Development in the Changing World, and it was very successful, with over 900 participants.

The U.S. Section PIANC (International Navigation Association) held its Annual Meeting October 20, 2004 in Baltimore, Maryland. A morning business meeting was followed by an afternoon seminar on Container-on-Barge Transport: Implications for Navigation Infrastructure. The U.S. Section Commissioners also held a meeting during this event.

The second U.S. Section PIANC Scholarship was awarded to Jonathan Rager, a top junior Ocean Engineering student at Texas A & M University.

The U.S. winner of the 2004 DePaepe-Willems Award was Ms. Shana Heisey of the U.S. Army Corps of Engineers Institute for Water Resources. Her paper was entitled "Determining Economic Efficiency in Harbors, HarborSym, An Application."

Representatives to Committees and Commissions: The principal business of PIANC is the sponsorship of technical working groups. The U.S. Section is represented by Principal and Co-Principal members of the Commissions managing the activities of the technical working groups. The representatives were:

Environmental Commission – Mr. Edmond Russo, U.S. Army Corps of Engineers, New Orleans District (U.S. Principal Representative), and Dr. Robert Engler, Engineer Research and Development Center (Chairman of the Environmental Commission).

Inland Navigation Commission – Mr. Shiv Batra, President of INCA Engineers, Inc. (U.S. Principal Representative) and Dr. Sandra K. Knight, P.E., USACE, Engineer Research and Development Center (Chairman of the Inland Navigation Commission).

Maritime Navigation Commission – Mr. E. Dan Allen, Moffatt & Nichol.

Recreational Navigation Commission -- Mr. Richard B. Dornhelm, Moffatt & Nichol; Co-Principal, Jack C. Cox, TetraTechFW.

New Technical Working Groups: In 2004, four new Working Groups were formed. The groups are listed below along with the name of the Principal U.S. Representative.

MarCom WG 49 – Horizontal and Vertical Dimensions of Fairways, Mr. Michael J. Briggs, U.S. Army Engineering Research and Development Center.

EnviCom WG 15 – Environmental Aspects of Dredging and Port Construction Around Coral Reefs and Cold Water Hard Bottom Benthic Communities, Ms. Penny Cutt, U.S. Army Corps of Engineers, Jacksonville District.

InCom WG 28 – Developments in Automation and the Remote Control of River Works, Mr. James McCarville, Port of Pittsburgh.

InCom WG 29 – Innovations in Navigation Lock Design, Mr. David M. Schaaf , U.S. Army Corps of Engineers, Louisville District, and Mr. Dale Miller, INCA Engineers, Inc.

Working Group Reports Published in 2004: **InCom WG 24**, Guidelines and Recommendations for River Information Services

Active Working Groups and the names of the U. S. Representatives:

InCom WG 21, **Economic Studies of Inland Waterways**. Mr. David Grier, USACE, Institute for Water Resources.

InCom WG 23, Technical and Economic Problems of Channel Icing. Mr. Claude Strauser, USACE District, St. Louis.

InCom WG 25, Maintenance and Renovation of Navigation Infrastructure. Dr. James McDonald, USACE-ERDC (retired) was the U.S. representative and chaired the committee. Mr. James Blanchar, USACE-MVR (retired) served as corresponding member.

InCom WG 26, Design of Control Structures Used on Navigable Waterways: Controllable Weirs and Gates. Mr. Dale Miller, INCA Engineers and Dr. Richard Stockstill, USACE-ERDC.

InCom WG 27, Guidelines for Environmental Impacts of Vessels. Dr. Thomas Keevin, USACE-St. Louis District.

MarCom WG 36, Catalogue of Precast Elements. Dr. Billy L. Edge, Texas- A&M University.

MarCom WG 39, Monitoring of Breakwaters. Mr. James D. Prehn, RLS, Special Data Survey.

MarCom WG 42, Life Cycle Management of Port Structures – Implementation Manual. Dr. Valery M. Buslov, Hans-Padron Associates.

MarCom WG 43, Minimizing Harbor Siltation. Dr. John Headland, Moffatt & Nichol.

MarCom WG 44, Accelerated Low Water Corrosion. Dr. Ashok Kumar, USACE-ERDC.

MarCom WG 45, Post Earthquake Actions for the Restoration of Port Structures. Dr. Stephen Dickenson, Oregon State University.

MarCom WG 46, Maritime Freight Transshipment, Ms. Doris Bautch, Maritime Administration, U.S. Department of Transportation.

MarCom 47, Criteria for the Selection of Breakwater Types and their Optimum Damage Risk Level, Dr. Jeffrey A. Melby, USACE ERDC.

MarCom WG 48, Guidelines for Port Constructions, related to Bowthrusters, Mr. Marcel Hermans of the Port of Portland and Mr. Gary Greene, Gary Greene Engineers.

RecCom WG 14, Access to Sport and Recreation Boating for Persons with Disabilities. Mr. Daniel Natchez, Daniel S. Natchez and Associates, Inc.

RecCom WG 15, The Use of Alternative Materials in Marina Construction. Mr. Terrence Browne, Collins Engineering.

RecCom WG 16, Protecting Water Quality in Marinas, Mr. Jack Cox , TetraTechFW and Mr. David Dykstra, Moffatt & Nichol.

RecCom WG 17, Guidelines for Marina Design, Mr. Dennis Kissman, Marina Mgt. Services, Inc.

EnviCom WG 8, Generic Biological Assessment Guidance for Dredged Material. Todd S. Bridges, Ph.D., USACE-ERDC and Mr. Thomas H. Schadt, Anchor Environmental, LLC.

EnviCom WG 9, Environmental Impacts of Polar Marine Activities. Jon E. Zufelt, Ph.D., USACE, ERDC, Cold Regions Research Engineering Laboratory.

EnviCom 10, Environmental Risk Assessment in Dredging and Dredged Material Management. Dr. Jerome Cura, Menzie-Cura & Associates.

EnviCom 11, Management, Dredged Material Re-use and Transformation of Existing Confined Disposal Facilities. Dr. Michael Palermo, USACE-ERDC.

EnviCom WG 12, Sustainable Waterways within the Context of Navigation and Flood Management, Dr. Craig Fischenich, U.S. Army Engineering Research and Development Center and Mr. John D. Clarkson, USACE, Huntington District.

EnviCom Experts Group 2 , Environmental Benefits of Waterborne Transport, Dr. David A. Moser, USACE, Institute for Water Resources.

EnviCom WG 13, Best Management Practices Applied to Dredging and Dredged Material Disposal Projects for Protection of the Environment, Mr. Thomas Wang, Anchor Environmental LLC and Dr. Douglas Clarke, USACE ERDC.

EnviCom WG 14, Dredged Material Beneficial Use Options and Constraints, Mr. Richard F. Gorini, J. Simmons Groups, Inc.

INTERNATIONAL BOUNDARY WATERS BOARDS

In order to carry out United States obligations under international agreements, the Office of the Chief of Engineers and several Corps divisions and districts with jurisdiction over areas bordering Canada have representation on numerous international boards, committees, and other groups. The majority of these boards were established by the International Joint Commission (IJC) as empowered in accordance with the provisions of the Boundary Waters Treaty of 1909 between the United States and Great Britain (for Canada). IJC boards fall into two broad categories: boards of control, which are more or less permanent and supervise compliance over an IJC order; and engineering, technical, or study boards, which are usually dissolved after completing and reporting on an investigation assignment.

In addition to boards created by the Commission, other international boards and committees are created by treaties or other arrangement in matters concerned with the water resources of joint interest, and the members report directly to the Governments or establishing agency. International boundary waters boards and committees having Corps of Engineers memberships during the fiscal year are listed in Table 45-1. For an explanation of the constitution of the various boards and committees, see the annual reports, Volume II for fiscal years 1977 and 1980.

In recent years the IJC has adopted an ecosystem approach for its Boards with a view toward amalgamating a number of its Boards, where it makes sense to do so, as a first step in the development of international watershed Boards. This approach stemmed from the Commission's recommendations in its 1997 report to the governments of the United States and Canada. This report was provided at the request of governments for a proposal on how the IJC might best assist them to meet the environmental challenges of the 21st century. Subsequently, governments asked the Commission, in a reference dated November 19, 1998, to further define the framework for operation of international watershed boards as recommended by the IJC in its 1997 report. The IJC provided governments with a December 2000 status report on the matter and several of its boards have been amalgamated since 1998.

TABLE 45-1
International Boundary Waters Boards Having Corps of Engineers Members

BOARD NAME	YEAR ESTABLISHED	UNITED STATES REPRESENTATION
1. Int. Lake Superior	1914	* Division Engineer, Great Lakes and Ohio River Division -- Chicago District Engineer -designated Alternate
2. Int. St. Croix River**	1915	*District Engineer, New England District
3. Int. Lake Memphremagog	1920	*District Engineer, New York
4. Int. Lake of the Woods Control Board	1925	*District Engineer St. Paul
5. Int. Lake Champlain	1937	*District Engineer, New York
6. Int. Kootenay Lake	1938	*1. District Engineer, Seattle 2. Dept. of Interior, USGS, Boise, ID
7. Int. Rainy Lake Board of Control	1941	*District Engineer, St. Paul
8. Int. Osoyoos Lake	1943	1. District Engineer, Seattle 2. *Dept. of Interior, USGS, Tacoma, WA 3. Washington State Parks & Recreation Commission, Olympia, WA

BOARD NAME	YEAR ESTABLISHED	UNITED STATES REPRESENTATION
9. Int. Red River Board ***	2000	1. District Engineer, St. Paul 2. * Dept. of Interior, USBR, Billings, MT 3. Dept. of Interior, EPA, Denver, CO 4. Dept. of Interior, USGS, Bismarck, ND 5. Mayor, City of Fargo, ND 6. ND State Water Commission, Bismarck, ND 7. MN Pollution Control Agency, Detroit Lakes, MN 8. MN Dept. of Natural Resources, Bemidji, MN 9. ND Dept. of Health, Bismarck, ND
10. Int. Niagara	1953	1. *Division Engineer, Great Lakes and Ohio River Division -- Chicago District Engineer -designated Alternate 2. Dept. of Energy, FERC, Wash., D.C.
11. Int. St Lawrence River	1953	1. *Division Engineer, Great Lakes and Ohio River Division Chicago District Engineer-designated Alternate 2. Civil Engineer, Retired 3. NYSDEC 4. Rochester Institute of Technology 5. Atlantic Philanthropies
12. Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data	1953	1. * Great Lakes and Ohio River Division 2. Dept. of Commerce, Ann Arbor, MI
13. Int. Niagara Committee	1955	*Division Engineer, Great Lakes and Ohio River Division
14. Int. Souris River Board ****	2001	1. District Engineer, St. Paul 2. *ND State Engr., Bismark, ND 3. Dept. of Interior, USGS, Bismarck, ND
15. Columbia River Treaty Entities	1964	1. Division Engineer, Northwestern Division 2. *Bonneville Power Admin., Portland, OR
16. Columbia River Treaty	1964	1. *HQUSACE, CECW-ZB, Wash., D.C. 2. Department of Energy, Tucson, AZ
17. Int. Champlain-Richelieu	1975	1. *New York Dept. Environmental Conservation 2. District Engineer, New York 3. Vermont Environmental Conservation. Agency 4. New England River Basins Commission, Staff Associate 5. Dept. of Interior F&WS, Boston, MA
18. Lake Ontario - St. Lawrence River Study Board	2001	1. * Institute for Water Resources (IWR) 2. NY Department of Environmental Conservation 3. Cornell University 4. Rochester Institute of Technology 5. Saint Regis Mohawk Tribe 6. 6. Private Citizens (2)

* Signifies U.S. Section Chairman

** In September 2000, the International Joint Commission formally combined its existing International St. Croix River Board of Control and its International Advisory Board on Pollution Control - St. Croix River and established the International St. Croix River Board.

*** Amalgamated Board Comprised of Former Int. Red River Pollution Board and Red River Portion of Former Int. Souris-Red Rivers Engineering Board

**** Amalgamated Board Comprised of Former Int. Souris River Board of Control and Souris River Portion of Former Int. Souris-Red Rivers Engineering Board

Comprehensive Study on Regulating Water Levels on Lake Ontario and in the St. Lawrence River

In FY2001, the International Joint Commission formed the Lake Ontario - St. Lawrence River Study Board to undertake a comprehensive five-year study to assess and evaluate the current criteria used for regulating water levels on Lake Ontario and in the St. Lawrence River. The Study Board engaged by the IJC is a bi-national group of diverse experts from government, academia, native communities, and interest groups representing the geographical, scientific and community concerns of the Lake Ontario - St. Lawrence River system. The U.S. Director of the Study is from IWR. The Corps of Engineers leads 5 of the 9 Technical Work Groups, and participates on 2 others.
The Mission of the Study is to consider, develop, evaluate and recommend updates and changes to the 1956 criteria for Lake Ontario-St. Lawrence River water levels and flow regulation, taking into account how water level fluctuations affect all interests and changing conditions in the system including climate change, all within the terms of the Boundary Waters Treaty. The Study Board is completing its studies to provide the IJC with the information it needs to evaluate options for regulating levels and flows in the Lake Ontario-St. Lawrence River system in order to benefit affected interests and the system as a whole. These studies include:

a. Reviewing the operation of the structures controlling the levels and flows of the Lake Ontario-St. Lawrence River system in the light of the impacts of those operations on affected interests, including the environment;

b. Assessing whether changes to the Order of Approval or regulation plan are warranted to meet contemporary and emerging needs, interests and preferences for managing the system in a sustainable manner; and

c. Evaluating any options identified to improve the operating rules and criteria governing the system.

The Study Board will provide, by the end of 2005, three candidate regulation plans for the IJC's consideration. The Study Board will hold a series of public meetings in the summer of 2005 to obtain public input on the candidate plans prior to submitting them to the IJC.

Upper Great Lakes Plan of Study

The IJC has decided to revise its plan for an Upper Great Lakes Study. The original Upper Great Lakes Plan of Study was submitted to the U.S. and Canadian governments in 2002. Its purpose was to provide a plan to review IJC Orders for Lake Superior outflow regulation and consequently water level impacts on affected interests in the upper Great Lakes system from Lake Superior downstream through Lake Erie.

While this original intent of the Study has not changed, two more recent events that might impact the study will be added to the study plan. The first issue is that of possible ongoing physical changes in the upper St. Clair River, which could impact water level changes on the upstream lake (Michigan-Huron) and downstream lakes (St. Clair and Erie). The second issue is that the Lake Ontario – St. Lawrence River Study is nearing completion. This may provide many lessons learned to help streamline the Upper Lakes Study.

The IJC recently appointed an Upper Lakes Plan of Study Revision Team. The U.S. Team Leader is the Detroit District Commander. A draft revised Plan of Study will be completed in August 2005. Public meetings will be held in September 2005. Following public consultation the final Plan of Study will be submitted to the IJC in October 2005. Any actual implementation of the Plan of Study would not be initiated until funds are appropriated by the Governments of the United States and Canada.

REGULATORY, SUNKEN VESSEL REMOVAL AND NATIONAL EMERGENCY PREPAREDNESS ACTIVITIES

1. Regulatory Activities

Authorities. The following authorities charge the Corps of Engineers with the regulation of various construction related activities in U. S. waters and wetlands: Sections 9 and 10 of the Rivers and Harbors Act of 1899 (structures in waterways and the alteration of waterways); Section 103 of the Marine, Protection, Research, and Sanctuaries Act of 1972 (Ocean Dumping); and Section 404 of the Clean Water Act (discharge of dredged or fill material).

Work Completed. During FY 2004, the Corps reviewed and authorized approximately 89,500permit activities, 88 percent of which were approved within 60 days. About 7,400 projects were issued individual permits, and another 82,000 activities were reviewed and approved under regional or nationwide general permits. General permits are issued to the public at large and define types of minor activities with no more than minimal adverse effects on the aquatic environment, which do not usually require the extensive review necessary for projects authorized by individual permits. Use of general permits provides significant relief to the regulated public by avoiding red tape for small projects with minimal environmental impacts. The Corps denied approximately 300 permits during FY 2004 since most projects which might otherwise have been denied a permit were either modified or conditioned to meet Corps requirements, scaled down to qualify for approval under general permits, or withdrawn. About 4,200 permit applications were either withdrawn or canceled. Under the regulatory program, the Corps made over 78,000 jurisdiction determinations in FY 2004, many of which were made in response to requests from landowners who were not applying for permits

The Corps investigated approximately 5,900 alleged illegal activities, most of which were violations of Section 404 of the Clean Water Act. Under the permit program in FY 2004, the Corps authorized the filling of approximately 22,000 acres of wetlands but required the restoration, enhancement, or creation of approximately 47,000 wetland acres.

As required by section 314 of the National Defense Authorization Act for Fiscal Year 2004 (P.L. 108-136), the Corps is drafting regulations establishing performance standards and criteria for compensatory mitigation required for Department of the Army permits. The regulations will apply equivalent standards, to the extent practicable, for compensatory mitigation done by permittees and mitigation banks. The rule will also establish standards for the review, approval, and operation of mitigation banks. The statutory deadline for promulgating the final rule is November 24, 2005.

TABLE A
GENERAL REGULATORY FUNCTIONS

Obligations		
Unobligated Balance - 30 Sep 03	$	5,032,772
Allotments	$	139,395,064
Total Funds Available	$	144,427,836
Obligations	$	141,158,327
Unobligated Balance- 30 Sep 04	$	3,269,509
Expenditures		
Unexpended Balance - 30 Sep 03	$	8,748,621
Allotment	$	139,395,064
Total Funds Available	$	148,143,685
Expenditures	$	143,385,902
Unexpended Balance - 30 Sep 04	$	4,500,806

Investigation and Removal of Sunken Vessels

Under the authority of Sections 19 and 20 of the River and Harbor Act of 1899, the Corps of Engineers investigated sunken vessels in navigable waters and removed those obstructing navigation.

For obligation expenditures, see Table B (next page)

TABLE B
REMOVAL OF SUNKEN VESSELS
($000)

Obligations	
Unobligated Balance - 30 Sep 03	$ 0.6
Allotment	$ 475.9*
Total Funds Available	$ 468.6
Obligations	$ 65.8**
Unobligated Balance - 30 Sep 04	$ 0.9
Expenditures	
Unexpended Balance - 30 Sep 03	$ 0.6
Allotment	$ 468.0*
Total Funds Available	$ 468.6
Expenditures	$ 65.8**
Unexpended Balance - 30 Sep 04	$ 0.9

* $500 less O&M Savings and Slippage
****** $401.9 Reprogrammed Out Of This Program During FY 2004

2. National Emergency Preparedness Activities

Authority. Executive Orders 10480 and 12656 and the Federal Emergency Management Agency (FEMA) under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 USC 5121 et seq. are the basis of the Federal Response Plan. The cited executive directives assign significant responsibilities for such preparation (planning, training, research and testing) to the Corps. This includes responsibility for development of comprehensive national level preparedness plans and guidance for response to all regional/national emergencies, whether caused by natural phenomena or acts of man, plans for response(s) to acts of terrorism, and the local preparedness necessary to support Corps continuity of operations. The Corps provides engineering and construction support to state and local governments in response to catastrophic natural/technological disasters. Rapid response to disasters of a regional/national magnitude requires that extensive pre-emergency planning and preparedness activities be conducted to assure the availability of a work force capable of shifting from routine missions to crisis operations and the organizational command and control structure(s) necessary to provide a coordinated and comprehensive response in the critical early stages of a catastrophic disaster.

Status. During FY 2004, the Corps of Engineers continued its effort to improve the command's readiness posture and its ability to respond to various national/regional catastrophic disasters to include terrorists' attacks. Emphasis has been on those activities to prepare for catastrophic natural and technological disasters requiring major Federal support of state and local governments overwhelmed by a disaster event, and for national level emergency water planning. The primary focus during FY 2004 continued to provide support to two major national level civil planning areas: (a) support to the nation's ability to mobilize national assets to meet national/regional level emergencies and (b) support to continuity of government and continuity of operations during national emergencies. Lessons learned from past hurricanes, floods, earthquakes, and events of September 11, 2001 as well as more recent events such as the six major hurricanes that made landfall in the United States during the 2004 hurricane season, clearly indicate that improvements in response to catastrophic disasters are still required. In this regard, the Corps continues to emphasize a program that uses the deliberate planning process to develop scenario specific catastrophic disaster plans. This will result in more detailed planning and should provide for a more comprehensive response to national/regional catastrophic disasters to include terrorist attacks. More extensive coordination with

Federal, state and local entities will be incorporated into plan development. In this regard, following FEMA's program focus, USACE continues to play a key role in national security planning such as supporting Homeland Security strategic planning efforts, development of the National Capitol Region Response Plan and other plans as the New Madrid Earthquake, the South Florida Hurricane, the Southern California Earthquake, the New Orleans Hurricane and other contingencies with national implications. Additional efforts focus on continuing to strengthen COOP readiness. Exercises, involving federal, state and local officials, contribute to a more timely and effective execution of Corps responsibilities during disasters that have national impacts. Major efforts have been made since September 11 for continued inter-jurisdictional collaboration in planning, training, and exercising to improve preparedness for a terrorist event in the NCR. A regional response to a WMD incident requires intense intergovernmental and inter-jurisdictional collaboration and cooperation, as was evidenced by the response at the Pentagon 9/11 incident. Continuing to capitalize on existing planning efforts and forums, and taking advantage of the current atmosphere of urgency regarding emergency preparedness will advance preparedness among all levels of government to improve response and ensure the health and safety of citizens, workers, and visitors in the metropolitan Washington region. A HQUSACE Table-Top Exercise (TTEX) was held on 4 May 2004 in Washington, DC. The format of the TTEX was revised from previous events in that it was not executed as a scenario driven tabletop exercise, but rather as a "HQUSACE Round Table" discussion with a general theme of "Readiness in the USACE 2012 Environment." The primary goal of the HQTTEX was to provide a facilitated forum in which senior HQUSACE staff principals and MSC representatives could work together to ensure continued readiness to respond to any contingency by reviewing preparedness/response roles and expectations; identifying, through focused discussions, critical issues or shortfalls associated with the ongoing implementation of the USACE 2012 organization and new management tools while supporting the Global War on Terrorism and the Initial National Response Plan (INRP). Main topics included USACE 2012, Readiness XXI, New Initiatives e.g., National Response Plan (NRP)/National Incident Management System (NIMS), Catastrophic Incident Response Plan (CIRP), Port Readiness, and USACE Continuity of Operations (COOP). The U.S. Army Corps of Engineers (USACE) and the Federal Emergency Management Agency (FEMA) co-sponsored the 2004 Senior Leaders' Seminar (SLS) on 22-23 June 2004 in Washington, DC. The SLS used a tabletop exercise format to bring together Federal, State, local and private sector partners for candid, solution-focused discussion about infrastructure related issues from a terrorist incident, looking at both infrastructure protection and recovery. The SLS provided an excellent opportunity for the incident management community at all levels of government and in the private sector to gather to ensure our operations are efficient, effective, and complementary. The seminar also allowed USACE, FEMA and their partner agencies to further build a corrective action program to track the resolution of issues raised at the seminars and in disaster after action critiques. The SLS convened senior policy and operational personnel from selected federal, state and local government agencies and private sector organizations who reviewed and discussed the immediate impacts of recent Department of Homeland Security initiatives on the national response system; discussed current plans and strategies for resolving recovery issues identified in past senior leadership seminars, including disaster housing, contaminated debris management, and infrastructure restoration.; and examined the new operational relationships and protocols established by the NRP, particularly in emergency support function areas of Infrastructure, Mass Care, Housing and Human Services and Economic Stabilization, Community Recovery and Mitigation and the Catastrophic Incident Response Annex, to successfully coordinate recovery.

For National Emergency Preparedness fiscal year obligations and expenditures, see Table C.

TABLE C
NATIONAL EMERGENCY PREPAREDNESS

Obligations	
Unobligated Balance - 30 Sep 03	$ 1,517,710
Appropriations FY 04	$ 5,606,000
Total Funds Available	$ 7,123,710
Obligations FY 04	$ 5,318,819
Unobligated Balance - 30 Sep 04	$ 1,134,766
Expenditures	
Unexpended Balance - 30 Sep 03	$ 2,598,047
Appropriations FY 04	$ 5,606,000
Total Funds Available	$ 8,204,047
Expenditures FY 04	$ 2,974,601
Unexpended Balance - 30 Sep 04	$ 3,478,984

CIVIL EMERGENCY MANAGEMENT ACTIVITIES

Authority. Public Law 84-99 (33 U.S.C. 701n) (69 Stat. 186) provides the authority for the U. S. Army Corps of Engineers to provide a full spectrum of emergency management/disaster assistance activities using the Flood Control and Coastal Emergencies (FCCE) appropriation. Under PL 84-99, the Chief of Engineers, acting for the Secretary of the Army, is authorized to undertake activities including disaster preparedness for all natural disasters, Advance Measures (preventive measures when faced with an imminent threat of unusual flooding), emergency operations (Flood Response and Post Flood Response), rehabilitation of flood control works damaged by flood or coastal storm, protection or repair of federally authorized shore protective works threatened or damaged by coastal storm, and provision of emergency water due to drought or contaminated water source. Under The Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5121 et seq.) (88 Stat. 143) (The Stafford Act), the Federal Emergency Management Agency (FEMA) may direct USACE to use its resources to provide assistance in the event of a major disaster or emergency declaration by the President. Under The Stafford Act and its implementing National Response Plan, USACE has a standing mission to provide assistance in the area of Public Works and Engineering, Emergency Support Function #3, for response to a major disaster or catastrophic event.

Activities. Overall, the Civil Emergency Management Program ensures timely, effective, and efficient disaster preparedness, response, recovery, and mitigation projects and services on a nationwide basis to reduce loss of life and property damage under DOD, USACE, FEMA, and other agencies' authorities. Major disaster preparedness activities included: the review and updating of disaster preparedness and response plans to ensure viability; training personnel to ensure their capability to respond to disasters; procurement and propositioning of critical equipment and supplies which would likely not be available during initial stages of a response; periodic exercises to test and evaluate plans, personnel and training; and the inspection of Federal and non-Federal flood control projects to ensure their viability to provide flood protection. For each specific event, as needed, Headquarters augments its staff and the staffs of the impacted division/district(s) to manage the event, addressing areas such as resource allocations (dollars and people), funding emergency contracts, purchasing needed materials, providing technical and direct assistance, the logistics of moving people and materials, and coordinating with tribal/Federal/state/local agencies involved in the event. These augmentation activities include overtime for Headquarters, funding of field staff, emergency contracts, travel to the event area, purchasing materials and supplies, increased staffing to include providing Remote Sensing/ Geographic Information System (RS/GIS) services.

Significant Events. In Fiscal Year 2004, the U.S. Army Corps of Engineers (USACE) spent $51.5 million in direct expenditures under Flood Control and Coastal Emergency authorities and provided over $72.5 million in reimbursable support to FEMA.

All districts and divisions played direct or supporting roles in USACE disaster response in FY2004. The 2004 disaster season was highlighted by the four successive major hurricanes to hit the state of Florida

At the beginning of FY04 USACE provided both 84-99 and Stafford Act support to communities in West Virginia affected by annual flooding.

Technical assistance was provided by the Cold Regions Research Engineering Laboratory to several areas in New England suffering from ice jam flooding.

ESF#3 Team Leaders mobilized for several National Security Special Events during the run up to the 2004 Elections. No incidents occurred, but the mobilizations were used for training purposes.

The Hurricane Season began ominously with Hurricane Charley switching directions quickly and making landfall on the west coast of Florida on August 13th. Three weeks later Hurricane Frances hit the east coast. Eleven days later Hurricane Ivan Hit the panhandle of Florida, also

causing significant wind damage in Alabama, and flooding all along the east coast and Appalachian mountain region. Finally Hurricane Jeanne passed through Puerto Rico, causing wind and flood damage on its way to make landfall on the east coast of Florida on the 26th of September. The season stretched the entire corps resources and energy. Over 3000 Corps employees were deployed from their home station to assist in response and recovery operations. Portions of the following were provided in FY05; in total the Corps provided 500,000 tarps, 176,000 temporary roofs, 31 million liters of water, 160 million pounds of ice, 600 large generators, 2 million cubic yards of debris, and 1000 housing units to the hurricane victims. At the end of FY 04 several hundred Corps employees remained deployed in Florida, and many of the recovery missions were still om-going.